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Hamstring injuries prevention in soccer players: A current narrative review

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ABSTRACT

Background: *Recurrent subject, following a high recurrence rate, and increasing in recent years, hamstring injuries continue to be talked about in the world of amateur and high level sport.*

Methods: *Through this article, it is a question of approaching the injury mechanisms and the modifiable risk factors responsible for lesions of the hamstrings as well as the main therapeutic exercises requested in the scientific literature which have proved their worth in the management of 'an injured athlete.*
Results: *It is important to mention that it is necessary to take into account the analysis of the activity of a professional footballer in order to get as close as possible to the specificity of his position and the physical qualities required during a match in order to limit the risk of recurvitrorence. Some prevention programs, such as the FIFA 11+program or the ASPETAR program are still under-exploited by sports and health professionals, questioning their usefulness as well as their feasibility.*

Conclusion: *As a result, upgrading the paramedical and sports team with respect to current scientific data as well as communication remains a major point that it seems essential to address in order to raise awareness among current football players and future young athletes.*

Keywords: Hamstring, Prevention, Soccer, Injury mechanism, Risk factors

Abbreviations: BMI: Body Mass Index; EMG: Electromyography; NH: Nordic Hamstring; RTP: Return To Play

INTRODUCTION

Hamstring injuries are the most common non-contact injuries encountered in professional football, American football, rugby and athletics (especially in sprinters). They alone represent 12% to 17% of total injuries encountered in general, and more precisely, between 15% and 50% of injuries in professional football. [1-4]

These injuries therefore have both a financial and a socio-psychological impact [5-8]. In fact, the number of days lost varies between 8 days and 25 days (50 days at most to recover a level of sport similar to the period before the injury), in particular due to the location and severity of the injury [9]. This is due to a decrease in performance as well as competitiveness due to the unavailability of injured players [6].

Following this high rate of recidivism, it may be worth raising various points. First, it is important to know whether the physical therapy / rehabilitation programs are suitable for the problems. We can see from the scientific literature that the healing process is often described as "incomplete", which may be the consequence of suboptimal rehabilitation programs [9,10]. In addition, it is true that the RTP is often considered premature, often due to the pressure exerted by a rapid return to competitive play but can also be, due to criteria of RTP and return to inappropriate performance [11].

The goal of athleticism is to allow an athlete to return to sport and competition at a pre-injury level of performance, with minimal risk of recurrence. In line with this, it is worth considering the means that a health and sports professional must implement to achieve this. Therefore, what are the areas of work on which we must focus, depending on the scientific literature but also the reality on the ground and the constraints that apply? This article will discuss various points. First, we will discuss the injury mechanisms as well as the risk factors that lead to an injury to the hamstrings before discussing the main areas of care necessary for the rehabilitation of the injured athlete.

Injury Mechanism

There are two main mechanisms that lead to injury to the hamstrings. The most common in professional football is that which occurs during a high speed running (sprint type), from 80% to 100% of the athlete's maximum speed [5,6,10,12]. The second is that encountered during a slow "overstretching" stretching movement or during a "kicking" kick (position of hip flexion and knee extension) [13].

When running at high speed, the injury occurs during the terminal phase of the running cycle. During this phase, the hamstrings contract strongly while lying down to decelerate the knee in extension and the hip in flexion in order to rest the foot on the ground [9,10,12].

According to a 2016 study by Ekstrand et al, it turns out that the long portion of the femoral biceps is most often impacted 84% of the time, mainly due to a biomechanical and physiological reason [14,15]. Indeed, when the speed of the player goes from 80% to 100%, the long portion of the femoral biceps would present an increase and an unequal distribution of stresses on the proximal musculotendinous junction [16]. The femoral biceps would thus be the head of the hamstrings which would stretch the most with an increase in activity of 67% compared to an increase of 37% for the other two muscle heads (semi tendinous and semi membranous) [16].

Risk Factors

There is a consensus that the most obvious cause of the risk of hamstring injury is multifactorial [5,8,10,17]. The most cited risk factor being a previous injury to the hamstrings [4,10,11,17]. Indeed, a poorly healed anterior wound would present a residual scar tissue and of poor quality which could result from a decrease in the extensibility of the musculotendinous unit and therefore from a structural maladjustment following a reduction in the length of the muscle bundles. Of the femoral biceps [18]. A history of injury could thus induce neurological as well as biomechanical consequences (namely a reduction in voluntary activation and therefore disruption of the motor pattern).

Other factors such as fatigue, excessive workload, advanced age (over 30 years), stress due to fear and apprehension of returning to sport are also cited [6,9,10,17]. However, it has been shown that the BMI ratio does not have an influence on the incidence of hamstrings.

However, other modifiable risk factors prevail in lesions of the hamstrings. There is a lack of mobility of the hip flexor muscles [6,9,17]. Indeed, a lack of flexibility of the hip flexors (iliopsoas/quadriceps) induces an inclination of the pelvis during high-speed running, responsible for excessive stress on the contralateral hamstrings, thus placing the femoral biceps over a greater length (due to its insertion on the ischial tuberosity). Another factor such as a deficit in balance, coordination and control of the muscles of the lumbopelvic hinge may have a role to play due to its impact on the pelvis and on the motor pattern [6,10,4].

Another important factor concerns the imbalances in the balance of power between the hamstrings (eccentric) and the quadriceps (concentric) bilaterally as well as a strength deficit only of the hamstrings (eccentric) in the high speed phase [6,8,9.10]. Indeed an unequal power ratio, or a deficit of pure force would result in a decrease in the number of sarcomeres in series as well as in the length of the beams. We would have a displacement towards the external muscular course on the curve force/length of the muscle, thus allowing an increase in the total tension and a greater susceptibility to the lesions of the hamstrings [8,19,20].

It is interesting to note that these risk factors do not operate in isolation, but as a complex network. Hence the importance of a multidisciplinary consensus around the athlete in order to minimize the risk of injury.

An Optimal Return to Performance Protocol

In order to allow an athlete a "return to sport and performance", it is necessary that the rehabilitation protocol contains defined and proven criteria (namely specific tests) thus giving the right to our athlete to progress from a distance. Step to the next. Thus, some rehabilitation and re-athletic protocols, such as the ASPETAR protocol, allow the athlete's progression to be divided into 6 phases, each separated by specific criteria [21]. The main objective of phase 1 of the protocol would be to promote healing and simultaneously avoid any activity that could delay the process of returning to sport. Phase 2/3, also called the remodeling phase, and would consist of recovering a good range of motion and regaining full muscle function. Steps 4 to 6 concern the RTP phases: return to the field, return to sport and finally return to performance. It is during these last three phases that full sport specific participation is requested [21].

Thus, throughout the athlete's management, a balance should be struck between inducing good, positive adaptation to protect against injury and excessive exposure which increases susceptibility to injury. This is one of the fundamental principles that must be observed in all areas. Therefore, it will be necessary to gradually increase the workload in order to develop a good physical tolerance of the players, as well in the work of mobility, muscle strengthening, running and specificity in sport.

In addition, psychological factors, such as stress, apprehension, anxieties, in interaction with the pain experienced are parameters that must be taken into account because they contribute to the increased risk of injury.

PREVENTION

Many authors believe that hamstring injuries occur when forces exceeding the mechanical limits of the tissues cause mechanical disruption. Consequently, one of the prevention strategies (the most widely used) consists in increasing the capacity of the tissues to withstand stresses and thus raising the safety threshold for injuries [4,17].

Eccentric Muscle Strengthening

Muscle activation has the potential to influence functional and structural adaptations. Most of the studies performed suggest that the hamstrings are activated heterogeneously during different exercises.

Many scientific studies (the strongest evidence) support the use of eccentric exercise as proven to prevent hamstring injuries [4,6,10,11,19,20,22,23]. This type of muscle building increases the number of sarcomeres in series and therefore lengthens the muscle bundles in order to decrease overall tension. This therefore makes it possible to increase the force over longer lengths of the muscle (displacement of the peak of the force/length curve towards the average stroke) necessary for the function of the hamstrings allowing the limb to be decelerated during the terminal sway during a race at high speed. This modification of the architecture of the fascicles evolves in a positive way over time, the authors therefore recommend maintaining phases where athletes carry out their prevention program throughout the season, in order to minimize the risks.

The majority of studies include programs that include NH over periods ranging from 6 to 10 weeks. Other authors have shown that a training involving a low volume of NH at a rate of 8 repetitions per week would obtain the same advantages on the architecture and muscle strength of the hamstrings as a program comprising 100 repetitions per week [24,25].

There are a certain number of exercises that allow you to preferentially target selected muscles and structures. But why choose to target one structure rather than another? Timmins et al answer this question by raising the possibility that it may persist neuromuscular inhibition and thus lead to a change in structure as well as its long-term function after hamstring injury. Timmins et al demonstrate that atrophy of the long portion of the femoral biceps compared to the small portion is often found after injury to the hamstrings. Therefore, knowing how to isolate a muscle can be a gain in the management of the athlete [26]. Consequently, certain exercises such as the NH make it possible to target the short portion of the femoral biceps while the hip extension stresses the proximal part of the long portion of the femoral biceps [27].

High Speed Running and Sprinting

In comparison to muscle building exercises, only sprint exercises can help elicit maximum activity levels of the hamstrings [19,20]. In 2020, Mendiguchia et al come to the conclusion that sprint training is more effective than eccentric muscle strengthening exercises on lengthening the length of the biceps femoral fascicles as well as on other parameters such as the development of the horizontal force of the hamstrings. In comparison, at EMG, the semi-tendinus reaches 40% to 65%, the biceps femoris 20% to 40% and the semi-membranous is between 40% and 75% of the maximum stress evoked in sprint [19,20].

It therefore seems that running and sprinting work must be reworked when taking charge of the athlete and this as early as possible as soon as the specific criteria allow it. It remains to this day the only training to improve performance and mechanics in sprinting. Some authors suggest integrating sprint phases at least twice a week in athletes performing sprints in matches, so that chronic exposure to this type of stress allows tissue adaptation and thus re-familiarize the athlete with running, apprehension being a big factor in reduced performance and risk of injury.

In addition, we can see that the speed efforts in a professional football player are brief, repetitive and intense [28-31]. We can therefore deduce that it is a sport that requires high speed qualities but also explosiveness. Thus, it is advisable to recruit the anaerobic alactic energy sector in order to recruit the fast fibers of the muscles. The demand for this energy sector seems all the more important since the ability to win a match is intimately linked to actions carried out at high intensity. In 2007, Di Salvo et al. specifies that races carried out at high intensity are “The arguments for the superiority of a team over its opponent in decisive actions” [28].

Be careful, however, sprint sessions must be controlled, both qualitatively and quantitatively. Some authors agree that substitute players, returning from injury, or not performing the same amount of work are the most likely to be injured early in the return to competition. It is therefore necessary to adapt the return to sport by being the most specific:

individualize training and add additional chronic work phases (additional training session and specific exercises) in order to compensate for the lack of matches. Exposing players to large and rapid increases in sprint distance has been shown to increase the chances of injury to JIs, hence the importance of gradually increasing chronic workload. An athlete in order to increase their physical tolerance while reducing the risk of injury [4,17].

One could also wonder about the importance of having a good quality of race, in order to know if it would not be a factor predisposing to the injuries. But, as it turns out, there is currently no study showing that one way of running predominates over another in terms of injury prevention.

Muscle Control of the Trunk and Pelvis

The work of Silder et al. in 2013 presents the idea that a program combining balance exercises, coordination and trunk muscle work in parallel is essential in the management of the athlete [6]. Indeed a better lumbar pelvic coordination would act indirectly on the reduction of the risk of injury via a better control of the pelvis during the exercises, allowing the hamstrings to function at safer lengths and loads during athletic movements. It is during these exercises that the reintegration of athletic movements becomes meaningful and is necessary to improve sequencing and neuro motor control [4,10].

It is therefore necessary to be as specific as possible in order to best integrate the channels used by the athlete in his activities. It is necessary to get closer to the activity by varying the exercises, the modes of contraction, the rhythm, the muscle groups. Indeed the hamstrings are part of a whole and solicit the other muscles such as the glutes, the calves, the erectors of the spine, the abs is consistent in addition to the specific work of the hamstrings.

Soccer Skills

It seems useful to specify that the majority of the distances covered are not carried out in a straight line but include specific movements, backwards, sideways, diagonally, jumps, dribbles, tackles, passes, shots and rapid changes of speed and direction. The intensity can therefore change at any time [32]. These activities have a direct impact on the score of the match, and speed is inseparable from these technical phases during matches. Indeed, studies show that a player's running speed is strictly related to rapid changes in running direction, stops, changes in running pace, speed of perception, anticipation, reaction and decision making

In 2010, Sporis's study indicated, among other things, that certain positions such as midfielders are more likely to develop these technical phases, such as being able to make a greater number of changes of direction than other field players, this because of the specific nature of their position [33].

Therefore, decision-making as well as changes in direction are indirect factors that influence the intensity of players' races. A study by Sheppard and Young qualifies this as agility: "Rapid movement of the whole body accompanied by a change in speed or direction in response to an external stimulus". This agility mentioned in this study therefore states that the qualities of a footballer are not only physical but also cognitive. The reaction time on the ground, the coordination of the upper and lower limbs, and the quality of a neuromuscular control are inseparable elements of an effective decision-making during a sprint. These are factors that need to be worked on in order to improve the physical qualities of a player both in terms of performance but also injury prevention.

CONCLUSION

In conclusion, it seems that the main axes of rehabilitation are closely linked to the modifiable risk factors responsible for lesions of the hamstrings. Through scientific studies, it emerges from the main themes that it seems necessary to exploit in order to participate in an optimal return to sport for the injured athlete: eccentric strengthening, excellent neuromuscular control, through lumbar pelvic stability, lower limb and trunk balance and coordination, high speed running and sprinting work while looking out for psychosocial factors. It is important to mention that it is necessary to take into account the analysis of the activity of your athlete in order to best approximate the specificity of his position and his pre-injury physical qualities.

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