

Measures Contributing to the Prevention of Hamstring Strain in Sprinters

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Abstract. One of the most typical injuries among sportsmen is hamstring injury. Extreme muscle stretching or high-speed running activities make athletes more vulnerable to hamstring injuries. Especially for sprinters, hamstring injuries rank among the most frequent in sports and cause a large amount cost of time. Despite its frequency, it is still unclear how hamstring injuries occur. It is crucial to keep sprinters injury-free because they also have a high rate of re-injury, which makes it difficult for athletes to heal entirely from injuries. It is important to use a variety of techniques to help athletes avoid hamstring injuries if they want to prevent sprinters from suffering them. This article is a review of the essays focus on methods to prevent hamstring injuries, which aims to provide scientific and comprehensive methods to instruct athletes and coaches to better deal with hamstring injuries.

Keywords: hamstring injury; running, sprinting; hamstring injury prevention.

1. Introduction

Sprinting is a cyclical motion that combines foot-strike and swing with alternate support and flight motions [1] (shown in Fig. 1).

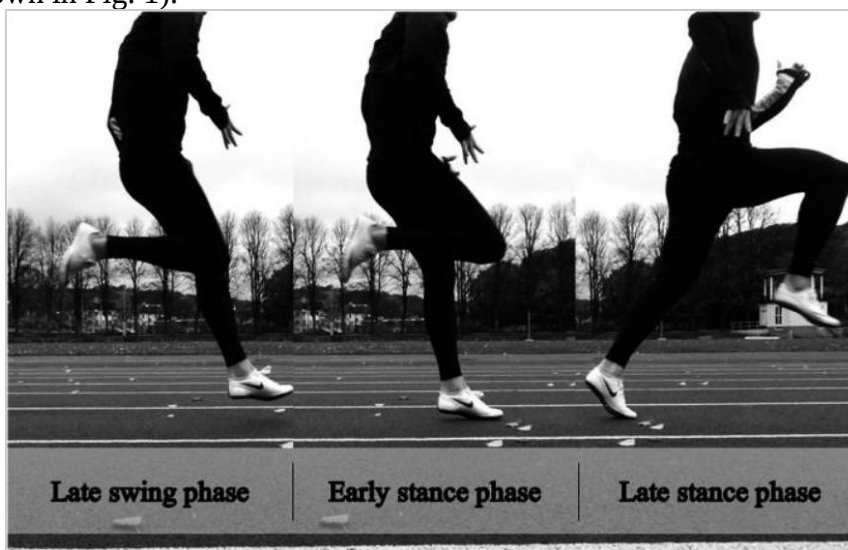


Fig.1 The running gait cycle [2].

Elite sprinters frequently suffer from hamstring problems, which can result in lengthy absences from practice and competition. However, there has been relatively little research on how to protect sprinters than hamstring injuries in ball sports (such as soccer and football). It is debatable whether hamstring injuries resulted from cumulative microscopic muscle damage through repeated use, or whether they were a reaction to an aberrant event that exceeded the boundaries of the unit of muscular tendon. The mechanisms frequently incorporate a variety of high muscle-tendon unit forces, muscle-tendon unit surpassing moderate lengths, and high speed movements.

In a theoretical model also suggest the risk of HSI may be affected by strength, flexibility, warm-up methods and fatigue [3].

When it comes to sprinters, hamstring injuries are often cause by a huge eccentric load in the late swing phase. And the most common reason is that most sprinters are lack of sufficient hamstring eccentric strength. Studies have confirmed the importance of hamstring eccentric strength in the late

swing phase and eccentric hamstring training plays a vital role in hamstring training and rehabilitation [4].

And other factors should also be considered such as the imbalance between hamstring and thigh muscle, flexibility, previous HSI and age [5]. Hamstring injuries are likely to happen when the hamstring has to decelerate the leg in the swing phase in running, lengthened at the same time [6]. However, many studies suggest that athlete trainers can combine eccentric hamstring strength training with many other interventions to prevent injuries.

Fatigue can also have a broad effect on sprinters, as fatigue is a variable in many factors, such as muscle strength, agility, flexibility.

Fatigue can decrease the eccentric peak hamstring torque. It decreases the active straight leg, which refers to a decrease in flexibility in some way. It also reduces neuromuscular coordination, which refers to a decline in agility [4].

The research results on sprint strength training in the past ten years show that the strength training problem of the sprinter's thigh muscles is the most important factor affecting the sprint movement, which is one of the main reasons for the improvement of athletes' performance. FMS is a good way to help detect the problem of sprinters body function and muscle control. The essence of Functional Movement Screening (FMS) is to use a simple method to capture information from athlete's basic movements, motor nerve control in movement patterns, and basic movement abilities, so as to accurately find the most serious parts of movement weaknesses and the athletes' abilities that are affected. Limitations and asymmetries are finally sorted out and merged to obtain relevant research results. The most serious asymmetries or defects can be tested, and corresponding adjustments can be made according to the needs of the action to make correct countermeasures, so it is easier to give suggestions for athletes' training and injury prevention, and then improve the sports performance ability in training or competition.

At present, FMS has formed a very standardized testing system and FMS is a main component of traditional sports training methods. FMS can detect weaker parts in human body movement patterns and can find wrong movement patterns.

So, this review mainly focuses on the training methods which can prevent hamstring injuries [4].

2. Materials and Methods

2.1. Search Methods

On September 4, 2023, a full electronic literature search was carried out with the assistance of a medical librarian utilizing three distinct databases: PubMed/MEDLINE, Google Scholar, and Chinese ZHIWANG. Each database's publications between 1 January 2015 and 30 September 2023 were examined using an advanced search that contained the terms "hamstring AND strain AND prevent* AND (sprint OR sprinting)."

2.2. Selection Criteria

To ensure consistent, unbiased selection of included research before database searching, a set of inclusion and exclusion criteria were created. Sports-related hamstring injuries were the only ones covered in the articles, leaving out tendon or avulsion injuries, which frequently signify distinct pathological diseases and may be linked to various risk factors. Studies had to address prevention, analyzing some part of risk or related variables, aiming to determine the risk factors for HSI.

3. Results

Stretching is a necessary way for athlete to decrease the rate of HSI risk. It can ensure athlete have abundant range of motion in their joint and decrease muscle stiffness.

Neuromuscular coordination is the key factor to keep a proper technique, which helps athlete keep away from injuries. Athletes' hamstrings must change from eccentric to concentric contraction

throughout the stretch-shortening cycle when running at full speed, placing a great demand on their neuromuscular coordination. Therefore, when there is muscle dyssynergy, such as a disruption of the contraction from the late-swing phase to the early-contact phase, athletes are more prone to sustain an injury [7]. To allow the athlete to maintain smooth movement during high-speed sprinting, the hamstring must function as a hip extensor and knee flexor in the early-contact phase. Therefore, hamstring damage during eccentric contraction may result from inadequate hamstring strength.

Body tissue's inherent flexibility governs the ROM that may be achieved at a joint or set of joints without bringing out damage.

From the FMS test conducted by professor Wang et al. reveal the problem. The active straight leg raise mainly detects stability of core, the strength of the separation ability of the lower limbs.

Th main reasons for losing points are as follows:

(1) During the straight leg raise, the stability of the pelvis and core is weak, resulting in improper control of the body's movements;

(2) Hip flexion is partially limited during leg lifts, and the hamstrings happen to be the most flexion-limited muscle in the anatomy of the human body.

(3) Excessive tension of the iliopsoas and anterior pelvic muscles also leads to hip limited joint extensibility [8].

4. Measure for Athletes to Follow

4.1. Agility Training

Agility help athletes adapt the rapid motion required at a supramaximal level of sprinting, athletes can perform even faster rate than the stride rate observed during supramaximal running, forming a excellent muscle synergy [9].

4.2. Fatigue Monitoring

Careful monitoring is essential for every coach to make sure that athlete are training in a proper volume, making sure that athletes can avoid sharp surge in training load and prevent the development of hamstring injuries. Athletes' physical condition should be carefully checked before training and numerical value should be conducted to measure the athlete's physical condition.

4.3. Strength Training

The muscle's capability to absorb and use high-intensity force when hamstring muscles are doing concentric contraction is important.

Nordic hamstring exercises can increase eccentric hamstring hamstring strength, thus decreasing injuries [3].

Isotonic training can be considered which has a significant improvement on hamstring muscle stiffness. While these workout types have positive impacts on hamstring muscle strength in and of themselves, combining the two may yield the highest enhancement in hamstring muscular strength for performance [9].

Hamstring muscle length can be increased with strength training, thus decreasing peak musculotendinous strains. From the experiment conducted by Ribeiro-Alvares at el., all subjects trained with nordic hamstring eccentric had increased fascicle length even some of them had no eccentric strength gain. A larger percents decrease on pennation angle was accompanied by a higher percent increase on fascicle length of the subjects [10].

Studies indicated that from a force production perspective, the Nordic-hamstring exercise conducted at 90of hip flexion was specific to sprint; nevertheless, hamstring muscle activity during this exercise was much lower than during sprint.

4.4. Pelvic and Core Stability

The essence of core stability training is to enable athletes to keep limbs and trunk stable under the condition. Improving core strength can improve the stability of the pelvis and spine, thereby improving the physical control and balance, which can not only improve the work efficiency of the body, but also prevent injuries caused by sports.

Equipment to strengthen core strength training mainly include: balance board, Swiss ball, vibrating rod, air cushion, etc. main training

Methods include: static force, dynamic force, combination of dynamic and static force, etc.

When training core, athletes have to obey the principle of starting from easy to difficult, first stable then unstable. Pelvis is the center that maintains the balance of the human body. It is at the link between the upper and lower parts of the human body.

Methods to strengthen pelvic stability training include clam opening and closing, supine up-and-down alternating leg swings, supine cross leg swings, and sitting V-shaped training.

4.5. Pay Attention to Warm-Up Exercise

Before spring training, people's muscles, ligaments, joints, organs and psychology should be motivated, especially the muscles have a certain degree of viscosity. Doing sufficient warm-up can not only appropriately activate the central nervous system, but also increase body temperature and promote blood circulation. The purpose is to increase muscle strength and elasticity, thereby enhancing conditioned reflexes and preventing hamstring muscles from losing weight during training. Strain due to excessive load.

Stretching can ensure athlete has enough range of motion in his joints to engage in sports activity effectively and reduce muscle stiffness. Dynamic stretching is a potential way to decrease the rate of HSI, as there is relevance with passive resistance to stretching [11].

4.6. Correct Bad Movement Patterns

Only by laying a good technical foundation can we gradually improve the training level. Training must follow the principle of gradual progress and correct mistakes in time during basic training.

Do this to improve the movement patterns on both sides of the hip joint. The quality of hip joint strength often affects the performance of sprinters. Hip joint training methods include lifting the barbell in a kneeling position to send the hips up, lunges, and supine hip thrusts. When an athlete's physical fitness reaches a certain level, there must be maintenance strength training.

During training, coaches should promptly discover athletes' bad movement patterns and correct them [8].

4.7. Sprinting

The degree to which the hamstring muscles were activated varied among the various strengthening activities, and none of them could do so as effectively as sprinting. Because of this, coaches should be aware that any hamstring conditioning or injury prevention program should include sprinting, which using hamstring muscle in an unrepeatable way [10].

5. Conclusion

Understand the factor that have relevance with the hamstring injuries, such as, high muscle-tendon unit forces (active or passive), muscle-tendon unit lengthening beyond moderate lengths, and high-velocity movements helps, people can take measures according to these factors as the underlying principle. Selecting a sort of articles, coaches should consider the plan of hamstring prevention from these aspects---agility training, fatigue monitoring, strength training, pelvic and core stability, proper movement patterns and sprinting itself to help athlete stay healthy and fit.

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