REVIEW

Which is the scientific evidence for prevention programs for muscle strains?

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ABSTRACT

Muscle strains are common in many types of sport if the biomechanical load becomes higher than the tolerance of the muscle. This can occur either if the biomechanical load is too high or if the tolerance against the biomechanical load in the muscle is reduced. Prevention of muscle strains should focus on preparing the athletes for the biomechanical load required by the specific type of sport. Studies have shown that sport specific prevention programs aimed at improving training specificity and fatigue resistance reduce the rate of hamstring strains. Specific training as provided by the "Nordic hamstring lowers" has also been shown to reduce the incidence of hamstring strains. Improving lumbar and pelvic function in high speed movements could also be of importance and high quality rehabilitation after muscle strains might reduce the rate of recurrent injuries. In the field of preventing muscle strains more evidence is needed to find the optimal prevention measures. There is need for more, well-conducted research on injury prevention in different types of sport.

KEY WORDS: Muscle injuries. Biomechanical load. Prevention.

RESUMEN

Las lesiones musculares son frecuentes en muchos tipos de deporte si la carga biomecánica pasa a ser superior a la tolerancia del músculo. Esto puede ocurrir tanto si la carga biomecánica es demasiado alta como si la tolerancia del músculo frente a este aumento de carga se reduce. La prevención de las lesiones musculares debería centrarse en la preparación de los atletas para soportar la carga biomecánica que requiere el tipo específico de deporte. Los estudios han demostrado que los programas de entrenamiento dirigidos al deporte específico y a la mejora en la tolerancia a la fatiga muscular reducen la incidencia de lesiones en isquiosurales. Un entrenamiento específico como proporcionan los "Nordic hamstring lowers" también ha demostrado reducir la incidencia de lesiones musculares en isquiosurales. Mejorar la función lumbo-pélvica en los movimientos de alta velocidad también podría ser de importancia. Igualmente, una rehabilitación de calidad tras la lesión muscular podría reducir el índice de re-lesiones. En el ámbito de la prevención de las lesiones musculares se requieren más evidencias de cuáles son las medidas óptimas de prevención. Se precisan un mayor número de estudios e investigaciones bien dirigidos sobre la prevención de lesiones en los diferentes tipos de deporte.

PALABRAS CLAVE: Lesiones musculares. Carga biomecánica. Prevención.

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Muscle strains are common in many types of sport and they usually occur if the biomechanical load becomes higher than the tolerance of the muscle. This can occur either if the biomechanical load is too high for the muscle or if the muscle's tolerance against a certain biomechanical load is reduced[1]. An example of an excessive biomechanical load are the mechanisms of hamstring strain during waterskiing, if the tips of the skies go under the surface of water during submerged take off, or into a wave, the skies decelerate suddenly. The skier's knees become extended and the trunk is pulled forward by the tow rope. This causes a forced hip flexion, followed by an excessive load on the hamstring muscles with subsequent strain or rupture[2]. Another example is hamstring strains during slow stretching in modern and classic dancing[3]. The tolerance against biomechanical load can be reduced due to many reasons. Examples of factors that possibly can lower the tolerance against biomechanical load are different types of sports and variable training status of athletes in the same type of sport. The training methods, as well as the training load and progression are important. The quality of training in junior sports is particularly important when building up different training effects such as strength, flexibility, power, muscle endurance, etc. in a sport specific manner. Fatigue late in training or competition can change the mechanical properties of the muscles and reduce their tolerance against biomechanical load. Previous injuries, with subsequent scar tissue formation can also reduce the tolerance of the muscle against biomechanical load. Other factors such as diseases and genetic variations can also be of importance in reducing the biomechanical tolerance of the muscles against load.

Muscle strains often cause significant time loss from competition and training[4-7]. Injury prevention is therefore of great importance in different types of sport. However, few studies are published on prevention of muscle strains and therefore few studies are available on evidence based prevention for this type of injuries. The aim of preventive programs should be to prepare the athletes for the biomechanical load required by the specific type of sport.

Preventive measures could be classified into the following categories:

- Identifying athletes at risk.
- Improving training specificity.
- Improving fatigue resistance.
- Improving eccentric strength.
- Improving lumbar and pelvic function.
- Improving rehabilitation programs to prevent recurrent injuries[1].

Identifying athletes at risk

In order to prevent sports injuries it is important to find the athletes who are at the highest risk in a particular group. Three important risk factors for muscle strains cannot be altered. Those are previous strains, age, and race. However, the players can be informed about their increased risk and it is possible to screen for other potential risk factors and work with them in attempt to lower their risk. Other important factors, such as inadequate fitness level and muscle fatigue late in competition or training, can be improved. It is also possible to increase muscle strength and treat lumbar or sacroiliac dysfunction or nerve root irritation as well as neuromyofascial tension[1,8].

It might also be of importance to identify high risk periods during the year. Such high risk periods could include training camps during the preseason period, where training amount and intensity often is higher than during the preceding period, as well as other changes such as with respect to the playing ground and weather condition. Another period could be the last part of the preseason period, where the training could be more intensive including a lot of training games. During the beginning of the competitive season some teams experience increased injury rate maybe because of a higher tempo, more games and, in the northern countries, a change from artificial turf to natural grass. During the end of the competitive season some teams also have an increase in injury rate possibly because the players are getting tired[9,10].

Improving training specificity and fatigue resistance

Improving training specificity can be of high importance in preventing injuries. When participating in sport at high level, an extreme level of fitness is required. Decreased fitness level could make the muscles more prone to muscle strains because of fatigue, but studies have shown that fatigue decreases the ability of muscle to absorb energy before failure[11]. Therefore, fatigued muscles may have less tolerance against biomechanical load especially during the eccentric phase of muscle work, where most muscle strains are presumed to occur. Some studies have also reported higher incidence of muscle strains late in games or during the end of first and second half[12,13]. In order to achieve a high level of fitness in a particular type of sport, the training must be sport specific. That is the training must reflect the situations and load during competition. Training methods should improve the muscle conditioning specifically for the particular type of sport as well as fatigue resistance. This is important so that the muscles can increase their tolerance against the biomechanical load required in each type of sport[1].

In a study performed in Australian Rules football, a prevention program for hamstring strains was investigated. The program consisted of an increased intensity in aerobic interval training, static stretching during brakes and at the end of playing and training sessions, a specific football training drill when players were changing running speed with the body in trunk flexion and the players also received an instruction regarding weight training of the lower limbs. The results showed that after implementation of the prevention program, significantly fewer games were missed because of hamstring strains and significantly fewer players suffered from hamstring strains[7].

Improving eccentric strength

During recent years, low eccentric muscle strength has been discussed as a possible risk factor for hamstring strains[14,15]. The exercise "Nordic hamstring lowers" has been shown to increase the eccentric and isometric hamstring strength. The exercise is difficult and it is recommended to start slowly with one set of five repetitions and increase the intensity in four or five weeks to three sets with 8-12 repetitions[16]. A large study has also been performed to test the effect of "Nordic hamstring lowers" on the incidence of hamstring strains in soccer players. The overall results showed that in teams that used "Nordic hamstring lowers" and stretching, 65% fewer hamstring strains incurred than in the teams that did not use it. The teams that used stretching alone did not demonstrate a significant change in the incidence of hamstring strains[15]. Another study on rugby players categorized the players into three groups: the first, strength training group, the second, strength training and static stretching, and the third, strength training, static stretching and Nordic hamstring lowers. The results showed that the total incidence of hamstring strains during match and training combined, and during training alone was significantly lowest in the third group i.e. among the players that used the Nordic hamstring lower exercise combined with stretching and other strength training program[17].

Flexibility

The role of flexibility in preventing muscle strains is unclear. Some studies have investigated a possible connection between muscle strains and poor flexibility[18,19], but the evidence for this is less convincing.

Improving lumbar and pelvic function

Some studies have indicated that neuromuscular control of lumbar movements and pelvic tilt, might be of importance in high speed movements such as sprinting and could be of importance in rehabilitation programs and prevention of hamstring strains[20-22].

Some authors also suggest some relationship between neural tension and posterior thigh pain[23,24]. Trigger points in hamstring or gluteal region, as well as mild nerve root irritation in the lumbar region can cause the hamstring muscles to become tight and possible cramping makes the muscles more vulnerable to strain.

Improving rehabilitation programs to prevent recurrent injuries

Studies have shown high occurrence of recurrent muscle strains especially in the hamstring muscles[6,25-27]. High quality rehabilitation after muscle strains, including not too early return to high intensity training or competition are of importance in preventing recurrent muscle strains. Gradual increase in stretching, strength training, running and sport specific movements after muscle strains are thought to reduce the risk of recurrent injuries. During and after the rehabilitation period it is also important that athletes are aware of fatigue and stiffness in their muscles, and they are followed up by medical personnel until they have reached their previous fitness level.

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