Academy of PHYSICAL MEDICINE

Research Paper Review

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Risk Factors for Hamstring Muscle Strain Injury in Sport: A Systematic Review and Meta-Analysis

British Journal of Sports Medicine 2013; 47: 351-358

Freckleton G & Pizzari T

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Risk Factors of Recurrent Hamstring Injuries: A Systematic Review

British Journal of Sports Medicine 2012; 46: 124-130

de Visser HM, Reijman M, Heijboer MP et al.

SUMMARY OF TWO SYSTEMATIC REVIEWS

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Background Information

Hamstring strains are common in many recreational and professional sports and activities, such as sprinting, jumping, or any movement that requires acceleration, deceleration, or rapid change in direction. These injuries are often recurrent and can result in substantial time lost from sporting activities (1-3).

Previous systematic reviews have examined the risk factors for hamstring injuries. Both concluded that hamstring muscle weakness, anterior-to-posterior thigh muscle imbalance, muscle inflexibility, previous hamstring injury and age are potential risk factors. However, the studies also concluded that these variables were inconsistent and are identified as associated factors in hamstring injury.

The aim of study number 1 (referenced above) was to determine the intrinsic and extrinsic risk factors associated with hamstring muscle strains in sport. Study number 2 attempted to provide an overview of, and rate the most current evidence for hamstring re-injury after an acute episode.

PERTINENT RESULTS

Study #1: Freckleton G & Pizzari T. Risk Factors for Hamstring Muscle Strain Injury in Sport: A Systematic Review and Meta-Analysis. British Journal of Sports Medicine 2013; 47: 351-358.

A total of 34 articles were included which sought to determine the risk factors associated with hamstring muscle injury.

Positive Risk Factors:

- *Age:* Athletes of older age tend to be at a higher risk of a hamstring injury (please note the P-value for this variable was not < 0.05, hence the phrase "tend-to-be").
- *Previous Hamstring Injury:* Represents a risk factor for future injury (RR: 2.68, 95% CI 1.99-3.61, p = 0.00).
- *Quadriceps Peak Torque:* Concluded to be a risk factor for hamstring strain injury during concentric contractions, but not eccentric.
- *Other previous injuries:* There is a relationship between a history of ACL reconstruction and recurrent hamstring injury, and a history of calf muscle strain (more than 8 weeks previously) with a new hamstring strain.
- *MRI imaging:* Those with an injury volume of > 21.8 cm3 are 2.3x more likely to be reinjured, while injury transverse size measurements > 55% of the total cross-sectional-area are 2.2x more likely to reinjure.
- *Leg length discrepancy:* a functional discrepancy of > 1.8 cm is a risk factor for hamstring strain.
- *Type of activity:* 68% of hamstring strains occur while performing running activities, while the greatest severity of injury occurred during kicking-type activities.

Factors Possibly Associated, but Requiring Further Research:

- *Hamstring flexibility*
- *Weight*
- *Hip flexor flexibility/hip extension ROM:* For each 1 degree increase on the Modified Thomas Test (i.e. decreased hip flexor flexibility), the risk of hamstring strain increased 15% in athletes ? 25 years.
- *Quadriceps flexibility*
- *Ankle dorsiflexion lunge ROM*
- *Playing position:* Rugby backs and soccer outfielders are at significantly greater risk when compared to forwards and goalies in these sports, respectively.
- *Proprioception (movement discrimination test).*
- *Mental imagery:* Slower times on a motor imagery task might be associated with subsequent hamstring injury.
- *Ethnicity:* Mixed results, with some evidence of increased risk in Aboriginal athletes and players of African-American decent.
- *Hamstring peak torque (strength):* A meta-analysis of 4 studies concluded that hamstring peak torque is only a risk factor during concentric contractions, not eccentric contractions. More studies need to be performed.
- *Hamstring/quadriceps ratio:* Soccer players have a 4.66x greater likelihood of hamstring strain if any player has a deficit on 2 or more isokinetic tests, indicating an imbalance in H:Q ratio. However, the evidence for isokinetic testing of the H:Q ratio for risk of hamstring strain injury is sparse when considered in isolation.
- *H:H ratio:* Lower hamstring:hamstring using isokinetic strength measurements leads to greater risk of hamstring strain. There is some variability in the direction of the contraction (i.e. concentric or eccentric).

Factors With NO Association to Hamstring Injury:

- *Body Mass Index (BMI)*
- *Height:* Did not differ between groups of injured and non-injured players.
- *Passive hamstring length*
- *Dominant limb*
- *Abdominal strength*
- *Aerobic fitness*
- *Pain provocation test*
- *Time to ascend stairs pain free*
- *Slump test*
- *Mechanism of injury*
- *Maximal power*
- *Counter movement jump (CMJ)*
- *CMJ on one leg*
- *Standing long jump*
- *Player exposure*
- *Jumping ability*
- *Knee laxity*
- *Running speed*

Study #2: de Visser HM, Reijman M, Heijboer MP et al. Risk Factors of Recurrent Hamstring Injuries: A Systematic Review. British Journal of Sports Medicine 2012; 46: 124-130.

This study sought to identify risk factors best associated with re-injury of a hamstring injury. Five studies met the inclusion criteria. The five studies reported a recurrence rate of hamstring injury of 13.9-63.3% in the same playing season, up to 2 years after the initial injury.

Factors including age, height, weight, time to return to sport, size of initial injury, volume of initial injury, Grade 1 tear rating according to Peetrons (4), hamstring muscle involved, location along the length of the muscle, pain severity score using VAS 12-18 hours after the injury, presence of hematoma, whether the dominant leg was injured, previous hamstring injury, previous ACL reconstruction and outcome functional tests were all rated as having limited evidence. Only the cross sectional area of the initial injury showed a lower quality of evidence, and was rated as conflicting.

CLINICAL APPLICATION & CONCLUSIONS

It is important to understand which factors are involved in the creation of a hamstring-strain type injury. Older age, increased quadriceps peak torque and a history of hamstring injury were the factors most strongly associated with an acute hamstring strain-type injury.

Additionally, the best evidence shows that recurrence occurs in 13.9-63.3% of hamstring injury sufferers. None of the variables identified in these studies showed a strong or moderate association with re-injury. Limited evidence was noted for a larger volume size of the initial hamstring injury, as measured via MRI. Additionally, limited evidence was found for grade 1 injury and a previous ipsilateral ACL reconstruction as possible positive risk factors for re-injury. A decrease in the rate of recurrence was found in studies of athletes who followed a rehabilitation program focusing on agility and stability, compared to a stretching and strengthening protocol. Re-injury rates also seem to decrease when patients with less severe initial trauma are included in studies. Conversely, they appear to increase with a longer wait until full return to sport.

In conclusion, according to the best evidence, it is possible to loosely predict which athletes may suffer an acute hamstring injury, and who may re-injure themselves after an acute hamstring injury. It may benefit readers to re-visit a previous review posted in February of 2012 on RRS, on the prevention of hamstring injury in male soccer players, so as to complete your understanding of identifying risk factors and the implementation of preventative measures to really protect our athletes as clinicians.

STUDY METHODS

Study #1: Freckleton G & Pizzari T. Risk Factors for Hamstring Muscle Strain Injury in Sport: A Systematic Review and Meta-Analysis. British Journal of Sports Medicine 2013; 47: 351-358.

The authors performed their literature search through a number of databases, including Medline, CINAHL, Embase, AMED, AUSPORT, SPORTDiscus, PEDro and the Cochrane library, and included all relevant articles up to August 2011. The authors also scanned the bibliographies of each selected article for additional references.

The authors used the following inclusion criteria:

- Diagnosis of hamstring muscle strain injury (primary or recurrent).
- Data examining hamstring injury and some aspects of risk, either intrinsic or extrinsic.
- Human subjects.
- Prospective studies.
- Must be published in a peer reviewed journal.
- English language.

Exclusion Criteria:

- Tendon injuries and general, non-specific studies examining MSK injury.
- Interventions attempting to reduce risk of hamstring injury.
- Retrospective studies, opinion summaries, case studies, cross-sectional studies and non-systematic reviews.

A quality assessment was performed to examine the potential bias of each article. A checklist consisting of 27 questions that has been validated for the assessment of methodological quality for both controlled and non-controlled studies was utilized. The Critical Appraisal Skills Programme (CASP) was used by the authors to assess the quality of the previously published systematic reviews.

Data extracted from each study included type of sport, participant numbers, sample details, number of injuries, risk factors investigated and how they were measured, how hamstring injuries were diagnosed in each study, length of time each participant was tracked through the course of a study and statistical results. Standardized mean differences and 95% confidence intervals were calculated. Relative risk, odds ratio and 95% confidence interval were recalculated when the selected studies did not provide adequate frequency data. A meta-analysis was performed for the proposed risk factors for hamstring injury. A random effects model was used to account for methodological or statistical heterogeneity, leading to a wider confidence interval around the pooled effect size – this creates a safer, more comprehensive option with more accurate information obtained. Heterogeneity was also reported, using I^2 statistic, where 0% indicated no observed heterogeneity, < 25% considered low heterogeneity, and 100% indicated a completely heterogeneous sample.

Study #2: de Visser HM, Reijman M, Heijboer MP et al. Risk Factors of Recurrent Hamstring Injuries: A Systematic Review. British Journal of Sports Medicine 2012; 46: 124-130.

A systematic review was performed. The PubMed, EMBASE, CINAHL and Web of Science were searched, up to 2011.

The inclusion criteria for this study were:

- The diagnosis of an acute initial hamstring injury, graded 1-3 via physical examination, or 0-3 using MRI or ultrasound, using the method outlined by Peetrons (4).
- A prospective study design, with a minimum follow-up period of 2 weeks after return to sport.
- Full text article.
- Article written in English, German or Dutch.

A consensus method was used to solve disagreements regarding inclusion. A third party was asked to give their opinion, should a consensus not be reached. Five quality criteria were used to judge external and internal validity. Studies were judged as high quality when at least 3 of the criteria were scored as a "yes."

Because of the inherent heterogeneity of the data with regards to outcome measures, determinants studied and methodological quality, a statistical data pooling of evidence was not performed. Instead, a best-evidence synthesis was performed. The level of evidence was ranked as such: strong, moderate, limited, conflicting and no evidence.

STUDY STRENGTHS/WEAKNESSES

Strengths

The inclusion criteria were very broad and, for the most part, allowed for the inclusion of many potential variables.

Weaknesses

With regards to re-injury, the large range of recurrence (13.9-63.3%) is likely due to varying lengths of follow-up. It is possible that with a longer follow-up period, more injuries could be reported. However, the highest and lowest recurrence rates were found in studies with similar follow-up periods (2 years). Thus, it is uncertain whether the length of time of follow-up has a specific relationship with re-injury rates.

Additional References:

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3. Valmassy RL. Clinical Biomechanics of the Lower Extremities. London: Mosby; 1996.
4. Peetrons P. Ultrasound of muscles. Eur Radiol 2002; 12: 35–43.