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Management of Physiotherapy in the Case of Hamstrings Injury

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ABSTRACT

Background: Hamstring strain injury (HSI) is the most common non-contact injury in several sports. Hamstring injuries usually occur during the late swing phase to the early contact phase of the gait, where hip flexion and knee extension co-occur. Risk factors for hamstring injuries have been reported to vary and include age, court position, muscle weakness, lack of flexibility, strength imbalances, and race. This study aims to summarize secondary data related to hamstring strain injuries.

Methods: The research method used was a literature study using secondary data from journals about hamstring strain injury obtained through Google Scholar, Science Direct, and PubMed.

Results: Several studies have shown that physiotherapeutic interventions, except low-level laser therapy (LLLT), are effective in increasing muscle strength, reducing injury severity, and speeding up the time to return to exercise in athletes.

Conclusion: Based on the results of the literature review, it can be concluded that providing interventions in the form of lengthening exercise, LLLT, Nordic curl exercise, and single-leg Roman chair can increase muscle strength, reduce injury severity, and speed up time to return to exercise.

Keywords: hamstrings strain injury, physiotherapy.

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Introduction

Hamstrings strain injury (HSI) is the most common non-contact injury in several sports. Although knowledge of risk factors and prevention methods has been disseminated, the incidence of HSI is increasing.[1] Hamstring injuries usually occur during the gait's late swing to early contact phase, where hip flexion and knee extension co-occur. Fast acceleration and maximum speed are related factors. Risk factors for hamstring injury have been reported to be diverse and include age, court position, muscle weakness, lack of flexibility, strength imbalance, and race.[2]

HSI can occur anywhere along the length of the muscle but is most common at the biceps femoris proximal to the musculotendinous junction. The long-head biceps femoris muscle is the hamstring muscle most frequently involved in first and recurrent injuries in 79% to 84% of HSI. Anatomically, increased anterior hip tilt can place the hamstring muscle group in an extended position and potentially increase the likelihood of HSI. Evidence suggests that muscle architecture (for example, higher pennation angles and shorter fascicle length) may contribute to HSI. At the time of injury, the individual experiences a sudden and sharp pain in the posterior thigh. In addition, an audible or palpable popping sensation often occurs during activities that tax and stretch the hamstring muscles. Individuals may stop events or activities because of pain and limited function.[3]

HSI often occurs in activities that involve high-speed running, jumping, kicking, and lowering bursts of limb movement with rapid changes in direction, including lifting objects off the ground. Therefore, sports such as track and field, soccer, Australian rules football, American football, and rugby have the highest reported frequency of injuries.[4,5] The estimated incidence of HSI per 1000 hours of exposure is 0.87 in non-contact sports and 0.92 to 0.96 in sports. Estimated incidence rates are 3 to 4.1 per 1000 hours of competition and 0.4 to 0.5 per 1000 hours of training for professional male European football players.[6]

High rates of recurrent HSI are associated with substantial loss of time in training and competition for athletes and increased costs for professional sports organizations. Optimizing re-injury risk assessment and return to sport/RTP decision-making is a priority for all stakeholders. The importance of determining when an athlete can safely RTP while minimizing the risk of re-injury remains high, especially after a severe HSI which usually requires a longer recovery.[7] Based on the description, some literature discusses interventions for HSI.

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Methods

The research method is a literature study using secondary data from journals about HSI obtained through Google Scholar, Science Direct, and PubMed. The literatures were searched with the following keywords 'hamstring strain injury', 'hamstring injury', 'exercise for hamstring injury', and 'hamstring strain injury and physiotherapy'. The inclusion criteria: 1) published in English between 2017-2022, 2) reported about HSI, 3) reported about exercise or home-based exercise for HSI. The exclusion criteria: 1) the result of the study is not reported, and 2) exercises for HSI are not reported.

Results

Robin Vermeulen et al. (2022) compared the effectiveness of early versus the delayed introduction of lengthening exercises with an addition to an established rehabilitation regimen on the time it takes to return to sport after an acute hamstring injury. Ninety male participants with an MRI-confirmed acute hamstring injury were randomly assigned to one of two groups: early lengthening (on day one of rehabilitation) or delayed lengthening (after being able to run at 70% of maximal speed). The primary outcome was the time it took to return to sport, and the secondary outcome was the rate of reinjury within 12 months of returning to sport. There was no significant difference between groups for reinjury rates within two months, 2 to 6 months, or 6 to 12 months, implying that speeding up the initiation of lengthening exercises in the rehabilitation of hamstring injury in male athletes did not enhance time to return to sport or risk of re-injury.[8]

Diulian Muniz Medeiros et al. (2020) performed a randomized controlled trial to investigate how low-level laser therapy (LLLT) affected functional rehabilitation after an HSI in amateur athletes treated with an exercise-based rehabilitation program. Male athletes who experienced HSI were randomly assigned to either LLLT or a placebo. Until they met specific requirements to resume their sport, all patients followed the same exercise-based rehabilitation regimen. LLLT or placebo was administered to the hamstring muscles during each rehabilitation session. Time to return to sport was the primary outcome. The number of rehabilitation sessions, hamstring flexibility, hamstring strength, and re-injury rate were secondary outcomes. Over the course of the rehabilitation treatment, both groups grew in flexibility and strength. Athletes receiving LLLT (23 + 9 days) and placebo (24 + 13 days) experienced the same time to return to sport. After returning to sport, there were no subsequent injuries within six months.[1]

Ben Macdonald et al. (2019) investigated the effectiveness of the single-leg Roman hold and Nordic hamstring curl in improving hamstring strength endurance. Twelve Gaelic football players with a history of hamstring injuries were randomly assigned to one of two training regimens: single-leg Roman chair holds or Nordic hamstring curls for six weeks. We measured the single-leg hamstring bridge (SLHB) before and after the treatment. The Roman chair group improved SLHB performance for both legs by a moderate magnitude. The Nordic curl group demonstrated an insignificant difference in SLHB performance for the non-injured leg. Compared to the Nordic curl group, the Roman chair group improved significantly in both the non-injured and previously injured legs.[9]

Yuki Hasebe et al. (2020) looked at various physical characteristics associated with hamstring injuries and the Nordic Hamstring Exercise compliance rate to determine whether this affected the hamstring injury rate. The 259 male soccer players from seven high schools were randomly assigned to one of two groups: a Nordic Hamstring Exercise group and a control group. In the control group, the rate of hamstring injuries was 1.04/10 000 hours, but in the intervention group, it was 0.88/10 000 hours. Injury to the hamstring had a relative risk of 1.14. With a relative risk of 9.81, the injury-related time loss rate was 1116.3/10 000 h in the control group and 113.7/10 000 h in the intervention group. Compared to a control intervention, the Nordic Hamstring Exercise dramatically decreased the severity of hamstring injuries in high school soccer players.[10]

Timothy F. Tyler et al. (2017) studied whether an eccentric strength training protocol with the hamstrings in a lengthened position resulted in a low recurrence rate. This study consisted of a three-phase rehabilitation program emphasizing eccentric strengthening with the hamstrings stretched out, which included fifty athletes with hamstring-strain injuries. At the time of return to sport, compliant athletes had complete strength restoration, whereas noncompliant athletes had significant hamstring weakness that worsened with muscle length.[11]

Discussion

Hamstring injuries are among the most common musculoskeletal injuries in the lower extremities. High-speed training and exercises with a high risk of injury recurrence in these people mainly cause these injuries.[12,13] The hamstring group comprises three posterior thigh muscles: the semitendinosus, semimembranosus, and biceps femoris. HSI may result in considerable impairment, activity limitations, and participation restrictions, including time lost from competitive sports. The high reinjury rate is also an important issue. Typically, HSI is classified by: the muscles involved, the anatomic location, and the severity of the damage.[3] Based on the description, some literature discusses hamstring injury intervention.

According to a study conducted by Vermeulen et al., the time to return to exercise (median 23, IQR 16–35 for early lengthening and 33, IQR 23–40 days for delayed extension) is comparable to the first Askling RCT protocol using lengthening exercise on soccer players (mean -28±15 days on average), but much faster than their second study in track and field athletes (49±26 days on average). Time to return to sport varied substantially across studies. This can be attributed to multiple definitions of return to sport, intervention, and (sport) population, which makes direct comparison difficult. For example, track and field athletes have different biomechanical and performance demands compared to our group, predominantly soccer players.[8]

The addition of LLLT to an exercise-based rehabilitation program, when implemented within the parameters used in the current study (850 nm, 90 J per session, three sessions per week), does not optimize recovery of flexibility or muscle strength, and does not accelerate return to exercise following HSI rehabilitation in the amateur athlete. Few animal studies started LLLT treatment within 24 hours of muscle injury, and it could be expected that treatment in these studies was started too late (48-96 hours after injury) to enhance the healing effect that occurs. The first 24-hour period is critical for the inflammatory process, so the impact of LLLT may have been strengthened by early therapy in this animal study. However, it would be difficult to reproduce it in clinical practice, especially with amateur athletes who do not have medical staff available full-time. Another aspect that needs to be pointed out is that the target tissue is deeper in humans than in mice, so LLLT is attenuated (i.e., reflection and refraction) by surrounding tissues, which impairs the absorption of light energy at the mitochondrial level and, consequently, reduces the physiological effects of LLLT on injured tissue.[1,14]

The Nordic hamstring curl exercise generates eccentric muscle fiber action, which has been used to modify the risk of a hamstring injury. Several studies have shown increased hamstring strength and fascicle length after a training program that includes the Nordic curl. Additionally, isometric loadings such as the single-leg Roman chair have been advocated as an alternative strength training intervention to prevent hamstring injuries. This study showed that a 6-week Roman chair single-leg program significantly improved the SLHB test more than a 6-week Nordic curl program in a sample of Gaelic football players. The increase in the SLHB score in the single-leg Roman chair group occurred similarly in the previously injured and uninjured limbs.[9]

Although the recommended protocol for hamstring Nordic curls includes multiple repetitions, there is usually a brief rest period between repetitions as the athlete returns to the starting position. Additionally, repetitions of the Nordic curl have been shown to last less than 3 seconds, with surface electromyographic levels of the hamstrings diminishing as the knee approaches terminal extension. Therefore, a prolonged activation pattern was not achieved compared to the single-leg Roman chair used in this study, in which the training protocol was started with a continuous contraction for 10 seconds. It has previously been shown that voluntary activation of the quadriceps is higher during sustained isometric contractions than during eccentric or concentric actions.[15]

According to a study by Hasebe et al., Nordic Hamstring Exercises in high school football players significantly reduced the severity of hamstring injuries. The hamstring injury rate in the NHE group was 1.14 times lower than in the control group, and the hamstring injury loss rate during sports showed a reduction of 1.52 times less time lost in the NHE group compared to the control group. These data show a positive effect in reducing hamstring injuries associated with NHE. NHE is associated with a significant increase in knee flexor strength and a substantial increase in sprint performance, increasing the length of the long head of the biceps femoris and shifting the maximum torque of knee flexion toward an extension.[10]

Hamstring injury prevention or rehabilitation programs should specifically target strengthening exercises that involve high-load eccentric contractions over the longer length of the musculotendon. In the study of Tyler et al., athletes who completed rehabilitation were followed for an average of 23 months after returning to play without re-injury. Reinjury only occurs in 4 out of 8 athletes who do not meet the rehabilitation program. Athletes who do not complete a rehabilitation program experience a reduction in strength that is more pronounced in the elongated state. Athletes with repetitive hamstring strains achieve peak isokinetic knee flexion torsion at the shorter muscle length on the involved side. For the compliant athlete, eccentric training in the extended state restores strength throughout the range of motion and provides a slight rightward shift in the length-tension curve. The mechanism by which eccentric exercise changes the length-tension relationship, or angle-torque, is thought to be the longitudinal augmentation of the sarcomere. Eccentric exercise of the hamstrings or quadriceps produces a rightward shift in the torque-angle relationship in healthy humans. This adaptation has been observed within one or two weeks of one eccentric exercise; this emphasizes the rapid plasticity of myofibrils.[11]

Conclusion

Based on the literature review results, it can be concluded that providing interventions in the form of lengthening exercise, LLLT, Nordic curl exercise, and single-leg Roman chair can increase muscle strength, reduce injury severity, and speed up a time to return to exercise.

Conflict of interest

No conflict of interest in this study.

Funding

No funding for this study.

Ethical consideration

This literature review used publicly accessible documents as evidence and does not require institutional ethics approval.

Author contributions

NLAS conceived the study design, wrote the manuscript, and searched the literature; IPKA revised the manuscript and searched the literature.

References

1. Medeiros DM, Aimi M, Vaz MA, Baroni BM. Effects of low-level laser therapy on hamstring strain injury rehabilitation: a randomized

controlled trial. Phys Ther Sport [Internet]. 2020;42:124–30. Available from: http://dx.doi.org/10.1016/j.ptsp.2020.01.006
2. Freckleton G, Pizzari T. Risk factors for hamstring muscle strain injury in sport: a systematic review and meta-analysis. Br J Sports Med [Internet]. 2012;47(6):351–8. Available from: http://dx.doi.org/10.1136/bjsports-2011-090664
3. Tosovic D, Muirhead JC, Brown JMM, Woodley SJ. Anatomy of the long head of biceps femoris: an ultrasound study. Clinical Anatomy [Internet]. 2016 Sep 1;29(6):738–45. Available from: https://doi.org/10.1002/ca.22718
4. Lee JWY, Mok KM, Chan HCK, Yung PSH, Chan KM. Eccentric hamstring strength deficit and poor hamstring-to-quadriceps ratio are risk factors for hamstring strain injury in football: a prospective study of 146 professional players. J Sci Med Sport [Internet]. 2018 Aug 1;21(8):789–93. Available from: https://doi.org/10.1016/j.jsams.2017.11.017
5. Timmins RG, Shield AJ, Williams MD, Lorenzen C, Opar DA. Biceps femoris long head architecture: a reliability and retrospective injury study. Med Sci Sports Exerc [Internet]. 2015;47(5). Available from: https://journals.lww.com/acsm-msse/Fulltext/2015/05000/Biceps_Femoris_Long_Head_Architecture__A.3.aspx
6. Martin RL, Cibulka MT, Bolgla LA, Koc Jr TA, Loudon JK, Manske RC, et al. Hamstring strain injury in athletes. J Orthop Sports Phys Ther [Internet]. 2022;52(3):CPG1–44. Available from: http://dx.doi.org/10.2519/jospt.2022.0301
7. Timmins RG, Shield AJ, Williams MD, Opar DA. Is there evidence to support the use of the Angle of Peak Torque as a marker of hamstring injury and re-injury risk? Sports Medicine [Internet]. 2016;46(1):7–13. Available from: https://doi.org/10.1007/s40279-015-0378-8
8. Vermeulen R, Whiteley R, van der Made AD, van Dyk N, Almusa E, Geertsema C, et al. Early versus delayed lengthening exercises for acute hamstring injury in male athletes: a randomised controlled clinical trial. Br J Sports Med [Internet]. 2022;56(14):792–800. Available from: http://dx.doi.org/10.1136/bjsports-2020-103405
9. Macdonald B, O'neill J, Pollock N, Bas Van Hooren A. Single-Leg Roman Chair Hold is more effective than the Nordic Hamstring Curl in improving hamstring strength-endurance in Gaelic Footballers with previous previous hamstring injury. J Strength Cond Res [Internet]. 2018;33(12):3302–8. Available from: www.nsca.com
10. Hasebe Y, Akasaka K, Otsudo T, Tachibana Y, Hall T, Yamamoto M. Effects of Nordic Hamstring Exercise on hamstring injuries in high school soccer players: a randomized controlled trial. Int J Sports Med [Internet]. 2020;41(3):154–60. Available from: http://dx.doi.org/10.1055/a-1034-7854
11. Tyler TF, Schmitt BM, Nicholas SJ, McHugh MP. Rehabilitation after hamstring-strain injury emphasizing eccentric strengthening at long muscle lengths: results of long-term follow-up. J Sport Rehabil [Internet]. 2016;26(2):131–40. Available from: http://dx.doi.org/10.1123/jsr.2015-0099
12. Ernlund L, Vieira L de A. Hamstring injuries: update article. Revista Brasileira de Ortopedia (English Edition) [Internet]. 2017;52(4):373–82. Available from: https://www.sciencedirect.com/science/article/pii/S2255497117300599
13. van de Hoef S, Huisstede BMA, Brink MS, de Vries N, Goedhart EA, Backx FJG. The preventive effect of the bounding exercise programme on hamstring injuries in amateur soccer players: the design of a randomized controlled trial. BMC Musculoskelet Disord [Internet]. 2017;18(1):355. Available from: http://dx.doi.org/10.1186/s12891-017-1716-9
14. Chung H, Dai T, Sharma SK, Huang YY, Carroll JD, Hamblin MR. The nuts and bolts of low-level laser (light) therapy. Ann Biomed Eng [Internet]. 2011;40(2):516–33. Available from: http://dx.doi.org/10.1007/s10439-011-0454-7
15. Ditroilo M, de Vito G, Delahunt E. Kinematic and electromyographic analysis of the Nordic Hamstring Exercise. J Electromyogr Kinesiol [Internet]. 2013;23(5):1111–8. Available from: http://dx.doi.org/10.1016/j.jelekin.2013.05.008