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Nordic Hamstring Curls are a Remedy for Hamstring Muscle Injury: A Narrative Review

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Abstract Nordic hamstring curls increase the hamstrings' eccentric strength, which reduces the muscle pull to a great extent in high-intensity sports athletes. This descriptive review study was carried out to assess whether Nordic hamstring curl workouts are effective in preventing hamstring muscle injuries. Hamstring injuries are a common soft tissue affliction frequently experienced by athletes, often resulting from eccentric contractions during high-speed movements. The inability of hamstring muscles to tolerate the stretching and strengthening demands of competitive sports is a significant cause of these injuries. The Nordic hamstring curl has emerged as a significant intervention for increasing eccentric hamstring strength and reducing severe injury risk. A thorough online search, including PubMed, Google Scholar, and Google Advanced Search Engine, yielded 63 relevant studies that provided authentic evidence. Results suggest that incorporating Nordic hamstring curls into a training regimen can potentially reduce hamstring injury rates by up to 70%. These exercises, when executed systematically and progressively, can increase muscle hypertrophy, strengthen the back of the leg, and improve the overall health of the knee. Adopting preventive strategies focused on generating stimulus through Nordic hamstring curls is crucial for athletes involved in high-intensity sports. It is no surprise that the Nordic hamstring curl exercise is one of the greatest hamstring muscle exercises for strengthening the back of the leg compared to other hamstring exercise protocols and building eccentric strength while lowering the threat of injury.

Keywords Nordic Hamstring Curls, Eccentric Strength, Hamstring Injuries, Muscle Hypertrophy

1. Introduction

Stretching exercises are repeatedly performed before engaging in any physical activity. Maintaining range of motion and practicing flexibility regularly will help prevent sports injuries. Games and sports may include competitive walking, running, jumping, and throwing. Every field and court activity necessitates a high level of aerobic and anaerobic fitness [1-3]. However, competitive sports often demand high-intensity, intermittent movements that require a variety of athletic actions, both with and without the use of a ball [4-8]. Team game players, on average, perform almost 700 turns and swerves at various angles [9]. Therefore, physical fitness is significant in boosting field performance [10]. Quick moves and stops, as well as quick direction changes, are essential for high athletic

performance [11]. Likewise, acceleration and maximal velocity are the two main components of sprinting. Without a doubt, both elements are essential for dribbling performance in team games [12]. On the other hand, players in different sub-disciplines face distinct physical and physiological requirements during their practice sessions [13]. Altogether, field sports like soccer, cricket, rugby, football, and hockey require athletes to improve bio-motor qualities such as endurance, strength, speed, and flexibility [14]. Similarly, team sport performance (court sports) is influenced by a multitude of elements, including body size, physical fitness, sport-specific ability, team strategies, and psychological factors [15, 16]. Indeed, regularly performing leg workouts is a crucial component of a comprehensive fitness regimen that enhances strength, agility, and overall stability. These exercises play a pivotal role in improving the overall fitness of individuals, especially athletes, as they target the muscles in the lower body [17].

Muscle tightness in the lower extremities is common for players. In this aspect, players normally suffer a lot because it hinders their movement efficiency. However, nonsurgical therapies work well for most hamstring injuries, and stretching can aid in pain alleviation [18]. Stretching the muscles can be done through different methods, such as reclining, sitting, or standing hamstring stretches. The use of a foam roller can also aid in the loosening of muscles. Strengthening the lower extremities may help prevent potential muscle tightness [19]. Squats, hamstring curls, and lunges are among workouts that target the leg muscles namely box jumps, deadlifts, calf raises, lunges, and single-leg deadlifts [20].

An athlete frequently suffers injuries to their lower extremities. Injury to the hamstring muscles is one of them. Acute hamstring strains can occur by overextending or inability to cope with eccentric load of the hamstrings, which may occur by running quickly [21]. Sport often involves bodily contact and is intermittent in nature. The majority of hamstring injuries are caused by overstretching or inability to tolerate eccentric load. During a variety of high-intensity athletic events, competitive athletes are expected to move with force and explosiveness. The Sports Physician is feeling distressed about the high rate of hamstring strain injuries and re-injuries in athletes [22]. Therefore, preventative strategies should be prioritized, which can be accomplished by appropriate eccentric muscular strength exercises at both high and low velocities, as well as conditioning drills aimed at fatigue reduction [23]. Eccentric training (strength) appears to be useful in the main and secondary prevention of hamstring strains, according to prior findings [24]. The Nordic hamstring curl is an effective method for preventing hamstring muscle injuries, as evidenced by earlier studies. Since the field of hamstring muscle injuries continues to evolve progressively, this study aims to provide a comprehensive outline of the endeavors undertaken to examine Nordic hamstring curls (NHE), which are one of the important remedies for hamstring muscle injury. Therefore, the purpose of this scholarly narrative review study was to see if Nordic hamstring curls exercise could help prevent hamstring muscle injury.

2. Materials and Methods

2.1. Acquisition of Facts

In this comprehensive narrative review, a meticulous online search procedure was employed to gather relevant evidence. Databases such as PubMed, Google Scholar, and Google Advanced Search were systematically explored to analyze the existing literature. Both the full texts and the abstracts of the potentially eligible articles were carefully read. After a thorough search, 63 studies were shortlisted for a systematic narrative review. Because the investigations were constrained and compiled in a narrative fashion, meta-analysis was not feasible in the present study. Each paper that the current authors assessed was published on a platform that is recognized by scholars. Within the framework of the field of physical fitness, every reference cited in this study was valid and reliable.

3. Characteristics of Hamstrings Muscle Injury

The hamstring muscles are skeletal, voluntary muscles in the human posterior thigh. The Semimembranosus, Semitendinosus, and Biceps Femoris muscles are collectively known as the hamstrings [25]. Both professional and recreational athletes suffer from hamstring injuries, which may sometimes cause severe impairment and disability. Hamstring muscle injuries are among the regular soft tissue injuries described, and their incidence and prevalence have been thoroughly documented in previous literature [26]. Athletes frequently sustain hamstring muscle injuries, which can range in severity from minor strains to total hamstring muscle complex ruptures. The hamstring muscles are typically injured when they are stretched to extreme joint positions or when they are eccentrically contracted while running [27]. The main cause of hamstring muscle injury is eccentric contraction while sprinting or running [28].

Due to the elevated occurrence of injuries, prolonged recuperation periods, and an increased risk of re-injury, hamstring strains remain a formidable challenge for both athletes and medical practitioners. Approximately a third of these injuries recur within the first year of resuming athletic activities, with subsequent incidents often proving more severe than the initial occurrence [29]. In connection with this, there has been an increase in the study of the prevention and management of hamstring injuries. However, epidemiological data suggest that injury and re-injury rates have not decreased, implying that rehabilitation

initiatives and the enhancement of criteria for resuming participation in sports are necessary [30]. Researcher Danielsson et al. [28] correctly point out that when the hips are flexed too much during knee extension, this leads to a stretch injury to the hamstrings. The primary cause of hamstring injury during sprinting is excessive muscle tension resulting from eccentric contractions during the late swing phase of the running gait cycle.

4. Non-contact Hamstring Muscle Injury

The hamstring muscle injury can be caused by a variety of factors, one of which is following significant body contact (contusion injuries). The majority of non-body contact hamstring muscle injuries can be seen in the competition. Running quickly is the most frequent reason for hamstring strains, whereas hamstring injuries related to over-stretching can occur during activities, such as high kicking, sliding tackles, and sagittal split [31, 32]. The most frequent non-contact injury in games is a hamstring muscle tear. They are linked to prolonged rehabilitation and have a high recurrence rate. The semimembranosus, semitendinosus, and biceps femoris all have lengthy heads that can all be affected by body contact with opponents in sports [33]. According to previous reports, hamstring injuries are the most frequent injury subtype, accounting for more than one-third of all strains and 12% of all injuries. These typically start with an acute onset (70%) and without any body contact from opponents (96%) [34]. Altogether, in all high-intensity sports and games like soccer, hockey, and handball, running at an excessive pace might result in a hamstring injury when the hamstring muscle is not prepared for high-speed running.

5. The Nordic Hamstring Curl Exercise

The previous sections' function of the hamstrings has not been discussed. Only possible mechanisms of injury to the hamstring muscle and potential issues have been provided/highlighted, with evidence from the literature to support this. However, the impact of Nordic hamstring training on the hamstring muscle has been demonstrated and discussed in past studies. The procedure of the Nordic Hamstring Curl is very easy. Participants kneel on the floor with their neck and head in a neutral stance, arms by their sides or across their chest, lower back and hips erect, knees bent at 90 degrees, and ankles securely braced by spotters. By supporting the ankles, the spotter was able to position themselves behind the participants. The spotter held the participants ankles steady. The participant was instructed to lean forward slowly and steadily, attempting to slow down the forward descent as long as feasible by engaging the hamstring muscles [35]. The early studies show that hamstring strategies to avoid injuries using the Nordic curls are a knee-dominant exercise, so they may not help prevent hip-dominant hamstring-related injuries as the sole intervention is very effective [36, 37]. There are two ways to complete the Nordic hamstring curl: assisted and unassisted [23]. The comprehensive Nordic hamstring curl exercise protocol was suggested by scientist Mjølsnes and his team (Table 1) [36].

Table 1. Exercise regimen for Nordic hamstring curls [36]

Week	Sessions per week	Sets	Repetitions
1	1	2	5
2	2	2	6
3	3	3	6-8
4	3	3	8-10
5-10	3	3	12,10,8

Similarly, regular amateur training using the NHE protocol dramatically lowers the occurrence of hamstring injuries, but it has little effect on the severity of hamstring injuries [38].

6. Importance of Eccentric Hamstring Strength

Sports like football, soccer, rugby, basketball, and track & field that demand quick sprinting, kicking, leaping, or high-speed motions are more likely to cause severe hamstring strains [39-45]. Eccentric muscle contractions provide strong forces at a minimal energy while also controlling excessive knee and / or hip flexion [46, 47]. When a muscle experiences a force greater than it can currently produce, it undergoes an eccentric contraction, causing the muscle and tendon to lengthen even as they try to contract [48].

Eccentric strength can help reduce the onset or possibly the severity of hamstring injuries [44]. Since the hamstrings may be eccentrically overstretched, such as during the final part of the late swing-phase in sprinting, this injury occurs [49]. Tight hamstrings can also hinder pelvic forward mobility and pull the pelvis back somewhat while straightening the lower spine [50]. The hamstrings' principal function during running and walking is eccentric control, which is necessary for the heel strike. Altogether, during the late swing phase, the hamstring complex contracts eccentrically in its entirety. Researcher Yu and his team found the hamstring muscles' peak eccentric contraction rates were significantly higher during the late swing phase, and the hamstring muscle-tendon lengths were significantly different than in the delayed stance phase ($p = 0.001$). Moreover, in the late stance phase, these lengths were considerably more extended than in the late swing phase ($p = 0.001$) [51]. Although many athletic movements and game specific skills are required to cover a

large area in games and sports, players must always be prepared to shift from offense to defense and vice versa. To adapt to the changing dynamics, players frequently adjust their speed and sometimes change their direction based on the demands of the game [52]. So, players require a significant degree of eccentric strength of hamstrings to complete these motor movements.

7. Connection between Eccentric Hamstring Strength and Nordic Hamstring Exercise

When compared to traditional hamstring curl exercises, the Nordic hamstring exercise is an excellent method for producing higher maximal eccentric hamstring strength torques [36, 53]. Since the Nordic hamstring curl exercise can help maintain the H:Q (hamstring to quadriceps) muscular strength ratio, it is a good tool to have [36]. Researchers discovered that using standard training for male professional soccer players; the Nordic hamstring exercise reduced the rate of hamstring injuries by approximately 65% to 70%. Reducing the incidence of hamstring injuries can be achieved by incorporating the Nordic hamstring exercise into regular training [54]. This method was especially effective in preventing repeated injuries [37, 55]. Furthermore, Nordic hamstring curls should be performed in a systematic, minimalistic, and gradual manner. This exercise's volume, repetitions, and pressure must be maintained. All things considered, the Nordic hamstring exercises, both with and without support, can enhance the eccentric strength of the hamstrings and decrease the likelihood of injuries [37, 55, 56]. According to Islam and his colleague, the hamstring muscle's lengthening capacity is reduced and stiffer if it is not eccentrically prepared enough. During the final late swing-phase of the running stride, a tight hamstring can restrict the pelvis from moving forward and this restriction may cause the pelvis to be pulled slightly backward, leading to a straightened lower spine posture [57, 58]. Consequently, the athlete is more prone to develop a hamstring injury. When compared to the traditional hamstring curl, the Nordic hamstring exercise is an excellent method for producing higher maximal eccentric hamstring strength torques [36]. The eccentric hamstring to concentric quadriceps ratios at various angular velocities is emphasized [57, 59].

8. Advantages and Disadvantages of the Nordic Hamstring Exercise

Numerous studies have demonstrated the value of Nordic hamstring curl exercise in lowering the frequency of hamstring injuries in a variety of games and sports. The NHE can be performed in a variety of ways and in different sessions to reduce hamstring strain. NHE, performed twice a week for four weeks by male football players, was proven to enhance knee flexor eccentric strength, as found in one study [60, 61]. However, it should be highlighted that despite a reported decline in hamstring strains, the severity of the symptoms remained constant [38]. Athletes perceive high degrees of exertion because they can still do the exercise to some extent even when they are extremely fatigued [36]. According to another study, athletes may benefit more from a smaller amount of NHE in order to improve intervention compliance and maybe reduce their possibility of suffering a hamstring strain injury [62].

Consequently, it is obvious that NHE has some drawbacks if the protocol is not followed correctly. Studies have indicated that the eccentric variant of the NHE is the main strategy for preventing hamstring injuries. Athletes frequently employ an eccentric-concentric variation of the NHE when competing in sports. On the other hand, the fast stretch-shortening cycle of the NHE may be a fascinating substitute for the typical slow eccentric version of the NHE because it might be advantageous for both the prevention and treatment of hamstring injuries as well as sprint performance. This was determined by comparing how the rapid stretch-shortening phase of the NHE compares to the traditional slow (eccentric version of the NHE) peak knee flexor force [63]. Furthermore, previous studies have indicated that NHE could be used in rehabilitation programmes for competitive sports.

9. Conclusions

There are many exercises known to loosen up tight hamstrings. Out of which, the use of a foam roller can help loosen muscles. Squats, different hamstring curls, lunges, box jumps, deadlifts, calf raises, the program for FIFA 11+ to prevent injuries, the bridge on a foam roller, Swiss ball exercises, and single-leg deadlifts are all leg-focused exercises that can help to avoid hamstring muscle injury. Nevertheless, for increasing muscle hypertrophy, the Nordic hamstring curl is the most effective exercise protocol [53]. Although Nordic hamstring curls are advanced workouts that are particularly difficult for beginners, they should go through smaller ranges of motion. This method is one of the best lower-extremity exercises for strengthening the back of the leg, reducing injuries, and enhancing knee health. This exercise's volume, repetitions, and load must increase while maintaining the test protocol. By preference, a Nord Board is a quick and simple approach to assessing the strength of the hamstring muscles during eccentric and isometric contractions. The Leicester City Club, champions of the English Premier League in 2015–16, used a Nord board regularly to build players' hamstring strength eccentrically [55]. For all counts and with proven findings, it is no surprise that Nordic hamstring curls exercise can aid with the prevention of hamstring muscle injuries substantially and build eccentric strength

while lowering the threat of injury.

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