

Comparison of Isokinetic Strength between Hamstring Injured and Non-Injured Leg in a Hamstring-Injured Athlete

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Rec date: Dec 23, 2014, Acc date: Jan 28, 2015, Pub date: Jan 30, 2015

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Abstract

The aim of this study was to determine whether there are any differences in hamstring strength indices of isokinetic concentric and eccentric peak torques at 60 deg/sec and 180 deg/sec between hamstring injured (left / non dominant) and non-injured (right / dominant) leg in a hamstring-injured athlete. A 25-year-old male recreational athlete who had hamstring injury, grade 2, twice in the past took part in the present case study. Hamstring concentric and eccentric peak torques were tested at two velocities: 60 and 180 deg/sec. The only difference was found in concentric peak torque at 60 deg/sec. Future well - designed studies are needed to find out whether there is a relationship between strength testing and hamstring muscle injury.

Keywords: Hamstring sprains; Isokinetic; Eccentric

Introduction

Hamstring strains are common injuries among athletes. Sprinters and footballers show a high incidence of these injuries [1-4]. Garrett, Rich and Nikolaou used computed tomography to show that the injuries are primarily localized proximally and laterally in the hamstring group, probably in the long head of the biceps [5].

The biceps femoris, semitendinosus and semimembranosus muscles comprise the hamstring muscle group. During running, the hamstring muscles become active in the last third of the swing phase undergoing eccentric contraction to decelerate knee extension and oppose the activity of the quadriceps. At ground contact, the hamstrings switch from maximal eccentric to concentric activity and develop the greatest force of any lower extremity muscles [6,7].

Hamstring strains are classified classically in three grades. A grade 1 strain involves a small number of muscle fibers and causes localized pain but no loss of strength. A grade 2 strain is a tear of a significant number of muscle fibers with associated pain and swelling. Pain is reproduced on muscle contraction. Strength is reduced and movement is limited by pain. A grade 3 strain is a complete tear of the muscle. This is seen most frequently at the musculotendinous junction [8,9].

There are several proposed causes of hamstring strains. Imbalance in strength between the hamstring muscles in each leg is one [10]. Another important factor for hamstring strains in soccer players as well as in sprinters is tight hamstring muscles [11,12]. Moreover, poor eccentric strength of the hamstring muscles might cause hamstring strains [13]. One more cause could be that the athlete returns to sport before he is fully rehabilitated [14]. Furthermore, fatigue and inadequate warm up [15], poor lumbar posture [16] and previous injury [17] have also been suggested as causes of hamstring strains. In addition, injuries influenced by lumbar spine and/or sacroiliac pathology-with or without tethering of the static neural tissue [13] have been previously postulated as causes of hamstring strains. Lastly, other factors including neural tension [18] and strength imbalance

between quadriceps and hamstring muscles [9] have all been suggested as possible predisposing factors.

The literature supports more than a single etiological factor as the cause of hamstring muscle injury. Moreover, contradiction exists concerning many of these factors. For example, some authors have reported that lack of hamstring strength and flexibility are common causes of hamstring strains while other authors have reported that lack of hamstring strength and flexibility are not causes of hamstring strains [19] believe that hamstring injury is a combination of four factors. These factors are lack of strength, lack of flexibility, improper warm up and fatigue. Obviously, this is speculative and further research is needed.

The literature is conflicting about the relationship between muscle strength and hamstring injury. Burkett and Christenson and Wiseman used cable tensiometers to assess isometric strength and found that the hamstring-injured players were weaker than the uninjured players about 10% [10,20]. Jonhagen *et al.* found that the uninjured sprinters had significantly higher eccentric hamstring torques at all velocities as well as they had significantly higher concentric torques at lower velocities than the injured sprinters [14]. Besides, Opar *et al.* and Orchard *et al.* found that injured players were weaker than uninjured players at all velocities in both kinds of contractions [17,21]. In contrast, Liemohn, Paton *et al.*, Worrell *et al.* and Bennell *et al.* did not find a significance difference in hamstring strength indices of isokinetic concentric and eccentric peak torques between hamstring injured and non-injured athletes [3,12,22,23].

The aim of this study was to determine whether there are any differences in hamstring strength indices of isokinetic concentric and eccentric peak torques at 60 deg/sec and 180 deg/sec between hamstring injured and non-injured leg in a hamstring-injured athlete.

Materials and Methods

Patient

The patient was a 25-year-old male recreational (training 4 times per week) footballer who had hamstring injury twice in the past. In both cases the injury was diagnosed by a specialist and was grade 2. The first injury occurred about 18 months ago and the second one occurred about nine months ago. In both injuries the patient avoided any activity for about 1 month and followed a rehabilitation programme, which consisted mainly of eccentric exercises. The left leg, non-dominant, was injured in both cases. The patient was asked to kick a ball to define the dominant leg. The leg was used to kick the ball was defines as dominant leg.

Equipment

The Kin-Com muscle dynamometer was used for testing muscle strength. The Kin-Com dynamometer is a hydraulically powered system in which the computer system can analyse eccentric and concentric work, power and torque at different angles and velocities. The Kin-Com dynamometer has a reliability exceeding at least 0.88 [24]. A concentric contraction occurs when the muscle contracts during shortening, while in an eccentric contraction the muscle lengthens when it is active. Eccentric contraction costs less energy and produces higher forces than concentric contraction [13].

Muscle strength assessment

Peak torque was evaluated. Before muscle peak torque testing, the subject went through a standardized warm-up schedule consisting of stationary cycling for ten minutes and stretching exercises of the hamstrings.

The subject sat with a hip angle of 80 degrees. The hip and the leg examined were anchored to the bench by belts to avoid extra movements. During the test, the subject held his arms folded over his chest. The motion axis of the Kin-Com system was aligned with the anatomical axis of the knee joint. The lower leg was placed in the resistance arm and the angle was calibrated with a plumb line. Correction was made for gravity effect on torque [25].

Hamstring concentric and eccentric peak torques were tested at two velocities: 60 and 180 deg/sec. Before the test at each velocity, the subject acquainted himself with the test by doing two or three trials, followed by ten maximal contractions. If any of the trials were unsuccessful, another contraction was allowed.

Each eccentric contraction was followed by a concentric contraction. The right leg (dominant/non-injured) was tested first at two velocities. Testing was first performed at 60 deg/sec and followed by 180 deg/sec. The subject started the tests at the lower velocities because this method was believed to be the least trying [14]. The range of motion was from 0° to 56°. The subject rested for around two minutes between the different velocities.

Results

The peak torque values of concentric and eccentric contractions between 0° and 56° in the hamstring muscles at 60 deg/sec and 180 deg/sec are shown in Table 1.

From Table 1 is obvious that no difference was found between hamstring injured and uninjured leg in eccentric peak torque at 60

deg/sec and 180 deg/sec as well as in concentric peak torque at 180 deg/sec. The only difference was found in concentric peak torque at 60 deg/sec.

Angular Velocity	Peak Torque			
	Concentric		Eccentric	
	Right Hamstring (Dominant/ Non-Injured)	Left Hamstring (Non-Dominant/ Injured)	Right Hamstring (Dominant/ Non-Injured)	Left Hamstring (Non-Dominant/ Injured)
60 deg/sec	65 Nm	36 Nm	53 Nm	53 Nm
180 deg/sec	49 Nm	40 Nm	65 Nm	55 Nm

Table 1: Bilateral concentric and eccentric hamstring peak torques at 60 deg/sec and 180 deg/sec.

Discussion

A 25-year-old male recreational athlete participated in this study, who had hamstring injury twice in the past. The left was the injured leg, which was the non-dominant leg and it was expected to be weaker than the dominant. However in the present trial no difference was found between hamstring injured (left/non-dominant) and non-injured (right/dominant) leg in eccentric peak torque at 60 deg/sec and 180 deg/sec, as well as in concentric peak torque at 180 deg/sec (Table 1). The only difference was found in concentric peak torque at 60 deg/sec, where the right hamstrings' peak torque was 65 Nm, while the left hamstrings' peak torque was 36 Nm (Table 1).

No difference was found in eccentric peak torques at both velocities, because the subject followed a rehabilitation programme, which consisted mainly of eccentric contractions. The difference in concentric peak torque at 60 deg/sec and no at 180 deg/sec can be explained by Jonhagen *et al.* [14] study, who support that the hamstring injured leg has a higher percentage of fast type 2 muscles fibres and responds better to high velocities than to low (slow) velocities.

The results of this case study do not correlate well with the results of previous experimental studies. In the introduction section was mentioned studies which showed that hamstring injured athletes were weaker than uninjured athletes in both contractions at all velocities, as well as studies which showed that there is not a significant difference in hamstring strength indices of isokinetic concentric and eccentric peak torques between hamstring injured and uninjured athletes. This case study showed a difference in hamstring strength only in concentric peak torque at 60 deg/sec. The results of a case study cannot be generalised to the rest of the population and future controlled studies are needed to find out whether there is a relationship between strength testing and hamstring muscle injury. Moreover, doing a literature review is obvious that the relationship between hamstring muscle injury and hamstring strength is not clear and further research clarifying the relationship of hamstring strength to hamstring muscle injury is needed. According to Bennell *et al.* [3] the inability to research to consistently show a significant relation between hamstring strength parameters and injury may be due to methodological differences (study design, sample size, type of athletes

and method of strength testing) or to the influence of confounding variables such as the potential for bias in unblinded clinicians. The area requires further investigation.

The procedure of the present study had some limitations. These limitations were: Firstly, the subject was a recreational footballer, while in previous studies athletes were professional footballers or sprinters. Secondly, the subject was not encouraged verbally and did not get biofeedback on his performance by following the torque curve displayed on the screen. This has been found to maximize the results [26,27]. Lastly, the range of motion was only 56 degrees, whereas in previous studies the range of motion was 90 degrees. These limitations led our study to have lower concentric and eccentric hamstring peak torques in comparison with previous experimental studies.

In summary, this case study showed no difference in eccentric peak torques between hamstring injured and non-injured leg in a hamstring injured athlete at both velocities, but it showed a difference in concentric peak torque at low velocities (60 deg/sec) and no at high velocities (180 deg/sec). Further well-designed trials are needed to confirm the results of the present case report.

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