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Editorial Open Access

Hamstring Strain Injury-Testing and Occurrence Prediction

Łukasz Oleksy[1,2], **Anna Mika**[1*], **Renata Kielnar**[3] **and Wojciech Czarny**[4]

[1]*Department of Clinical Rehabilitation, University of Physical Education in Krakow, Poland*

[2]*Oleksy Physiotherapy Clinic, Poland*

[3]*Faculty of Medicine, University of Rzeszów, Poland*

[4]*Department of Physical Education, University of Rzeszów, Poland*

[*]**Corresponding author:** Anna Mika, Department of Clinical Rehabilitation, University of Physical Education in Krakow, Poland, Tel: 48126831134; E-mail: anna.mika@awf.krakow.pl

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Editorial

A hamstring strain injury [HSI] is the most common noncontact injury in elite sport [1,2]. HSI represent 14% of all injuries in elite soccer accounting for 37% of all muscle injuries in professional sport [3]. The recurrence rate of HSI ranging from 16% to 60% across different sports discipline [2,4]. Risk factors for HSI include age, previous injuries, and changes in muscles strength, flexibility and fatigue [1]. A meta-analysis by Freckleton et al. identified age, previous hamstring injury and increased quadriceps peak torque as most important risk factors. However, the hamstring peak torque, hamstrings-to-quadriceps ratio, and eccentric hamstring strength were not associated with an increased risk of primary or recurrent HSI. But, they underlined that results from different studies are difficult to conclude, because of methodological differences [5]. The biomechanics of hamstring activity during running was evaluated by some authors [6,7]. They have found that the hamstrings are active from mid-swing to terminal stance [7-10]. Hamstrings contract eccentrically during running or kicking a ball, when they slow the forward swing of the leg to prevent overextension of the knee and flexion of the hip [11]. During those movements eccentric hamstring contractions produce strains, and probably microscopic damage to muscle fibers. It was suggested that those microscopic areas of damage may provide a point of weakness resulting a major tear [11-13].

But the major limitation of the studies investigating the hamstring biomechanics is that they generally do not differentiate between the behaviour of the muscle contractile element and other elastic tissues [14]. Studies have shown that the muscle contractile element and elastic tissues may behave differentially and therefore, lengthening of the motor unit does not necessarily indicate lengthening of the muscle contractile element [15,16]. Van Hooren et al. raised an important question, if during swing phase hamstrings actions are eccentric, concentric or isometric? They have suggested that elastic tissues could lengthen while the contractile element remains isometric, so increasing distance between the attachment points cannot simply be interpreted as an eccentric muscle contractile element action [14]. Isokinetic muscle strength assessment is a popular screening tool for identifying athletes at risk of future HSI [17]. Some studies found that isokinetic assessment is not predictive for HSI [18], while other studies found its predictive ability [19]. Some authors have suggested that hamstring strains were significantly associated with a low hamstrings-to-quadriceps ratio of peak torque on the injured side and a low hamstrings side-to-side ratio of peak torque [11]. But other studies have reported that hamstring strains are not related to a low hamstrings- to-quadriceps strength ratio [18] or they reported normal strength after injury [11]. Green et al. in meta-analysis have reported a week validity of isokinetic testing in hamstring injury prediction [17]. Specifically they underlined, that wide range of measurement protocols was used across the studies (concentric or eccentric isokinetic knee flexor, knee extensor and hip extensor strength were examined at angular velocities ranging 30-300°/s), therefore the results are difficult to interpret unambiguously. Based on their meta-analysis they have reported only a small predictive effect for eccentric knee flexor strength measured at 60°/s angular velocity. No other testing speed or strength ratio showed any association with future hamstring injury. But, they have suggested that the mechanism of hamstrings injury is more complicated and more research is needed in this area.

Van Dyk et al. examined whether differences in isokinetic strength measures of knee flexion and extension represent risk factors for hamstring injuries in professional soccer players [20]. They found small associations between lower hamstring eccentric strength and lower quadriceps concentric strength with hamstrings strain injury and concluded, that the use of isokinetic testing to determine the association between strength differences and HSI should be considered with caution [1,20]. Moreover they underlined that the small association between strength measurements and risk factors highlights the multifactorial nature of hamstring injury. The important aspect of isokinetic testing is the aim of this measurement. The standard protocol may be appropriate when we need to identify athletes with strength imbalances. It was indicated, that a concentric and eccentric isokinetic assessment may be useful as a preseason screening tool for early detection of strength imbalances, what is linked with hamstring injury [21]. It was reported that sprinters who were injured have weakness of the injured limb compared to the uninjured limb, specifically for the knee flexors eccentrically and the hip extensors concentrically, when tested with an isokinetic device at angular velocity 60°/s [22]. The important limitation of knee flexor and extensor muscles isokinetic evaluation is the standard seated position of the subject. This position with the hip joint flexed to 90° and full knee extension during measurement does not allow the knee flexors achieve the maximal range of motion and does not stretch the hamstring muscle group. Therefore it was suggested by Tyler et al. that hamstrings should be tested in stretched position, when function is assessed close to the true end of range of motion [23]. The other important issue is the accurate correction of joint torques and passive muscle tension during isokinetic testing. The gravity correction procedure due to limb mass involves a single measure of torque with the limb relaxed at a specific angle. It is typically performed in standard sitting position. But, when the hamstrings are in lengthen position it was postulated that more than 50% of the measured torque

may be due to the combination of limb mass and passive tension [23]. It may be the crucial confounding factor in isokinetic contractile torque measurement. The authors have suggested that this problem may be solved using isometric testing; therefore isometric testing is preferable to isokinetic [23].

Considering that hamstring strains often occur in positions of significant stretch, it was suggested that during rehabilitation it is important to provide eccentric strengthening with the hamstrings in a maximally stretched position [6]. Failing to increase an athlete's eccentric strength in a lengthened position after a hamstring injury may predispose an athlete to subsequent reinjury [24]. This approach was confirmed by Tyler et al. study where forty-eight athletes with unilateral hamstring strains followed a 3-phase rehabilitation protocol emphasising eccentric strength training with the hamstrings in a stretched position [25]. Prior to return to sport, isometric strength was assessed bilaterally at 80°, 60°, 40° and 20° knee flexion in sitting with the thigh flexed to 40° above horizontal. They concluded that rehabilitation with an emphasis on eccentric strength training with the hamstrings in a stretched position resulted in zero recurrent injuries at 2 years after return to play. Athletes who did not perform lengthened-state eccentric training had a high 50% recurrence rate [23,25]. Additionally Van Hooren et al. have suggested that because during the swing phase of running the action of hamstring contractile element is no eccentric, but rather predominantly an isometric, the isometric rather than eccentric hamstrings exercises are more appropriate and specific for runners [26]. The appropriate hamstrings evaluation protocols should be used for injury screening, managing rehabilitation and determining readiness for return to play. It appears that the standard isokinetic testing-concentric or eccentric may be useful for muscles weakness screening and for the evaluation of training effectiveness. The week association between isokinetic measurements and hamstring strain injury prediction allow suggesting that this option of assessment is not recommended. Based on data from the current literature it appear that the best mode of hamstrings evaluation in the context of injury prevention is the isometric bilateral flexion torque symmetry measurement when the hamstrings are in lengthened, fixed position. When deficits are within 10%, predisposition to reinjury is significantly reduced [24,27].

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