Abstractvorlage für den Nachwuchspreis; 6. Jahrestagung der SGS 2013 in Fribourg/Freiburg

Title:
Verletzungen beim Landen: Der Einfluss von schwachen Hüftabduktoren auf die Kinematik des Knies in der Frontalebene
Landing and Injuries: the role of hip abductor fatigue on frontal plane knee kinematics

Authors: S. Gafner¹, I. Punt¹, N. Place², S. Armand³, J.L. Ziltener³, L. Allet¹
1. University of Applied Sciences of Western Switzerland, HES-SO, Geneva
2. Institute of Sport Sciences, Faculty of Biology and Medicine, University of Lausanne, Lausanne
3. Geneva University Hospitals and University of Geneva, Geneva

Abstract:
Introduction:
A well functioning muscle corset is important for the participation in any kind of sport activities. Many popular sports like running [1], athletics [2] and team sports such as soccer [3] or handball [4] induce injuries to the lower extremity. Interestingly, most sports injuries (e.g. in soccer and rugby) occur in the second half of the competition and are thought to be fatigue induced [5].

Many studies examined the consequences of fatigue of ankle muscles on postural stability, but only few studies examined the proximal muscles of the lower extremities that are thought to be more important in balance performance [6]. Nevertheless, several authors demonstrated that hip abductor weakness and weak knee muscles lead to greater difficulties to maintain balance and postural control than weak ankle muscles [6, 7, 8]. These studies support the importance of the hip abductor strength on postural control, which is a pre requisite for being physically active. In the study of Henriksen [9] in which intramuscular hypertonic saline was injected in the gluteus medius to inhibit its activity a reduced internal hip abductor and external knee adduction moments during walking was revealed.

Hip abductors (gluteus medius, the upper part of gluteus maximus, tensor fasciae latae) also have a large impact on injuries of the lower extremities [10, 11]. Diseases like patello-femoral pain syndrome (PFPS) [11], anterior cruciate ligament (ACL) ruptures [12, 13] and chronic ankle instabilities (CAI) [14] have been shown to be related to hip abductor weakness or fatigue.

Knee injuries mostly occur during jumping, cutting (directional changes, lateral step) or decelerating movements [10, 12, 16]. Although some studies stated that hip abductor fatigue is related to different knee and ankle injuries, the direct effect of hip abduction fatigue on lower limb and trunk kinematics and kinetics remains unclear. Nevertheless, a recent review of Cashman et al. [16] showed, that the influence of hip abductor fatigue on these challenging movements, leading to injuries, has only barely been studied.

Therefore, the present study will examine the influence of hip abductor fatigue of healthy volunteers on kinematics of the lower extremity at the moment of landing after a single leg forward jump.

Methods:
Sixteen healthy participants aged 18-40 years (30.25±4.34 years) were included in our study. The hip abductors of the dominant leg (the leg the participants use to kick a ball with) were fatigued in a side-lying position on the non-dominant side of the participant using a dynamic repetitive movement (30 degree hip abduction, 60 beats per minute) [17]. In accordance to the study of Patrek et al. [17], the maximum voluntary isometric contraction (MVIC) of the
Hip abductor has been recorded in a side-lying position with a hand-held dynamometer that was fixed on a frame. The MVIC was recorded before and after the fatigue protocol (pre-post fatigue MVIC), as well as at the end of the single leg forward jump test (verification MVIC).

Knee valgus (in degree) at initial contact (IC) and the peak joint displacement (PJD) of the knee (degree) between IC and 500 ms after IC were measured using the VICON system. A one-way repeated ANOVA Data analysis was performed using SPSS version 21.0.

Results:
The mean pre- to post- fatigue MVIC decreased by 60.55% (pre-fatigue MVIC= 315.10±90.85 N; post-fatigue MVIC= 124.87±55.94 N). The maximum value of recovery at the end of the jump tests was 78.57% of the pre-fatigue MVIC, which means that all participants remained sufficiently fatigued until the end of the testing procedure (pre-fatigue MVIC= 315.10±90.85 N, verification MVIC 176.60±46.69N).

Five participants landed in a knee valgus position pre- and post-fatigue (-3.39°±2.00), 9 participants landed in varus position (+5.16°±2.56) and 2 others showed a varus angle pre-fatigue (+2.12°±1.27) and a valgus angle (-0.10°±0.02) post-fatigue.

After fatigue 8 participants increased their valgus angle or decreased the varus angle at landing. The contrary is valid for the other half of the participants. The PJD increased for 6 participants (1.76°±1.28) and decreased for 7 participants (1.55°±1.06) after fatigue. Three participants showed no difference in the PJD before and after fatigue.

Discussion/Conclusion:
The MVIC results show that participants’ hip abductor muscles really have been fatigued and remained fatigued during the whole testing session.

Contrary to our hypothesis, fatigued hip abductors did not increase the knee valgus at landing. Possible explanations could be a compensatory accentuated trunk lean to the contra-lateral side, as well as skin movement of the reflective markers during the jump task.

We can conclude that after a single leg jump people do either land in a valgus or varus angle of the knee and move then either in a valgus or varus direction during the following 500ms. Hip abductor fatigue does not seem to accentuate the knee valgus position, which is related to lower limb injuries. Studying the influence of trunk lean kinematics and more challenging tasks as cutting maneuvers seems to be necessary to better understand the effect of hip abductor strength on landing mechanisms and related risk factors for injuries.

References:


