DKG International Knee Day 2020

Role of activation patterns of hip muscles in single-leg squats in healthy patients

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Introduction: A risk factor for knee injuries is the medio-lateral displacement of the knee joint during a single-leg squat (SLS). It is to be supposed that different activation patterns of hip muscles are related to the medio-lateral displacement of the knee (1). Yet, little is known about the electromyographic (EMG) ratio between gluteus medius (GM) and the adductor muscles (ADD) at different knee flexion angles (2). Therefore, the EMG ratio between GM and ADD at different knee flexion angles was assessed during the SLS. These data should build a normative data base of healthy controls for getting in-sights on knee injury prevention.
Hypotheses: The hypothesis was that according to different knee flexion angles, there is a variabil-ity of the EMG ratio between GM and ADD in healthy patients.
Methods: A total of 17 healthy subjects (9 female/ 8 male, age of 25±4 years, BMI of 24±2 kg/m2) were included into the study. Exclusion criteria were Genu varum or Genu val-gum and pathologies which might affect coordination abilities of the lower extremities. Knee flexion angle was captured with a 3D motion analysis system (Vicon Motion Systems, Oxford,UK). Muscle activity of GM and ADD was measured by surface electromyography (Myon AG Schwarzener, CH). The EMG signal (10-500Hz band-pass filter, rectified, 250ms moving average) was normalized to maximum EMG am-plitude during a static maximum voluntary contraction against a handheld dynamome-ter (MicroFET2, Hoggan Scientific, UT, USA). The EMG ratio was defined as muscle activity of GM [%max] divided by muscle activity of ADD [%max]. Every participant did 12 single-leg squats on each side.
Results: EMG ratio (median, interquartile range (25th - 75th quartile)) was calculated at the fol-lowing knee flexion angles (mean ± SD): EMG ratio at start position (11°±6°) = 2.5 (1.9 – 4.2), EMG ratio at 40° downward movement = 1.5 (1.1 – 2.7), EMG ratio at 60° downward movement = 1.2 (0.9 – 2.2), EMG ratio at maximum flexion angle (86°±16°) = 1.3 (0.9 – 1.9), EMG ratio at 60° upward movement = 2.0 (1.2 – 3.3), EMG ratio at 40° upward movement = 2.3 (1.5 – 4.4), EMG ratio at end position (8°±6°) = 3.2 (2.3 – 5.4).
Conclusion: In the literature, the mean EMG ratios between GM and ADD at maximum knee flex-ion were ranged from 1.3 to 1.9 in healthy patients (3,4) and are comparable to our findings. The knee and hip have to be more stabilized during the upward movement by higher EMG ratios. The lower EMG ratio in the downward phase might be associated, amongst others, with the eccentrical deceleration movement. We assume that the consistently higher activation of the GM is attributed to its function as an essential hip stabilizer as well as to avoid a collapse in the knee joint in every single-leg situation. Therefore, we recommend hip abductor focused training to prevent knee injuries. Our results provide a basis for the comparison with patients and for the interpretation of medio-lateral displacements of the knee joint during a SLS.

The Orthopaedic Journal of Sports Medicine, 8(9)(suppl 7)
DOI: 10.1177/2325967120S00515