

Objective visualization of the effect of different knee flexion angles on medial-lateral displacement of the knee center in frontal plane during single-Leg Squat

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Introduction: The subjective single-leg squat (SLS) test can be used as a functional diagnostic agent to prevent knee injuries. [1] However, there are missing objective data about its functional rating, performance, squat depth and medio-lateral knee displacement in the frontal plane. [2] Therefore, the purpose of this pilot study was to evaluate the medio-lateral knee displacement in the frontal plane with a 3D motion capture system at different knee flexion angles during the SLS in healthy patients.

Hypotheses: The hypothesis was that according to different knee flexion angles, there is a variability of medial knee displacement (= valgus positions) in healthy patients.

Methods: 17 healthy and sporty subjects (9 ♀/ 8 ♂, age 25±4 years, BMI 24±2 kg/m²) participated in this study. Exclusion criteria were balance disorders, hip knee and/ or ankle complaints, surgery history, high deviation in lower extremity axis (i.e. Genu varum/ Genu valgus). Knee displacement was measured by 3D motion analysis system (Vicon Motion Systems, Oxford, UK) using a modified method of Krosshaug et al. [3] Thus, knee displacement was defined as distance between knee joint center and reference plane including the calculated hip and ankle joint center and the fixed toe marker on the second metatarsal head. A positive knee displacement was associated with a knee valgus, a knee varus was described as negative knee displacement. Every participant did 12 single-leg squats on each side.

Results: The following knee flexion angles of all SLSs were captured (°, mean and standard deviation (±)): start position at 11 ± 6; downward phase at 40 ± 0 and 60 ± 0; maximum at 86 ± 16; up-ward phase at 60 ± 0 and 40 ± 0; end position at 8 ± 6. The medio-lateral knee displacement of all SLSs showed at the mentioned knee flexion angles the following values respectively (mm, median, interquartile range (25th - 75th quartile)): -12 (-19 to -5); 0 (-9 to 7); 13 (-2 to 28); 38 (8 to 61); 17 (0 to 36); 4 (-6 to 16); -15 (-22 to -7).

Conclusion: According to different knee flexion angles, there is a variability of medio-lateral knee displacements in healthy patients. This variability should be included in the functional rating of a SLS as well as in the interpretation of different knee pathologies. Moreover, it provides an objective basis in the prediction of knee injuries.

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