

Comparison of Lunge and Bulgarian Split Squat Kinematics and Kinetics between a Subject with Patellofemoral Pain Syndrome and a Non-pathological Control

Faculty Sponsor: Karen Lomond, PhD

Authors: Nicholas Cahill, SPT, Michelle Flores, SPT, Abigail Merrill, SPT, Tyler Sheldon, SPT

ABSTRACT

Background: Patellofemoral pain syndrome (PFPS) and its relation to dynamic valgus in weight-bearing activities has been previously studied using both single and double stance dynamic bent-knee activities. While lunges are a popular subject of study and rehabilitation, the Bulgarian split squat (BSS), which is a more stability-intensive activity, has limited presence in the current literature about PFPS rehabilitation. Existing literature has determined that movement coordination impairment (MCI) type of PFPS presents as dynamic knee valgus in all squat-based exercises as opposed to no valgus in non-pathological controls⁴. The purpose of this study is to investigate the knee kinematics of a participant with the MCI classification of PFPS when performing a Bulgarian split squat compared to a lunge. Such comparison and analysis may help to inform rehabilitation professionals on the most effective sequence of return-to-sport interventions to best help individuals with MCI PFPS.

Methods: Pilot study. The two subjects in the study were 23 years old, Caucasian, of healthy BMI, and had no pathology or pain. The control subject performing typical squat mechanics was female, and the subject representing the PFPS condition by simulating a dynamic valgus was male. Each participant performed 3 Bulgarian split squats and 3 lunges with 3D motion capture reflective markers attached on the hip, knee and ankle. Data in the frontal and sagittal planes was averaged over 3 trials and compared.

Results: Increased hip adduction and knee adduction angles were observed in the dynamic valgus condition compared to the control for both a lunge and a BSS. Similarly, increased peak knee and hip adduction torques were produced by the dynamic valgus condition; these values were larger during the BSS than the lunges for both conditions. Larger hip extension moments were produced by the dynamic valgus condition.

Discussion: These results agree with various other studies that have considered the relationship between lunge variations and PFPS^{1,5}. The results have shown that performing BSS increases knee valgus, increases medial displacement of the hip joint and increases frontal projections angles, and therefore, greater stress may be placed on the medial knee joint. Choosing to perform a forward lunge instead of a BSS may be more beneficial for someone with PFPS due to its stability and the decreased peak valgus torques that are produced².

Conclusions: More stress may be placed on the knee joint for an individual who has a movement coordination impairment (MCI) type of PFPS and this stress may be greater during more unstable squat variations due to the increased torque placed on a knee that deviates further from a neutral position.

References:

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This is considered IRB exempt (IRB 151).