EVALUATION OF HIP MUSCLE ACTIVITY DURING SINGLE LEG SQUAT MOVEMENT USING MUSCLE SKELETAL MODELING

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Introduction

The single-leg squat (SLS) test is one of assessment tool that has gained popularity to provide a snapshot of overall biomechanical function and to identify potential neuromuscular deficits in the lower limb kinetic chain [1]. Muscular weakness may adversely affect several functionalities that are expected to be performed by gluteal, tensor fascia latae muscles. The most important role of the gluteus medius muscle is provide stability for the pelvis and lower extremities during the walking, running, jumping, or squatting movements. Decreased hip muscle activity can increase dynamic knee valgus position during functional movements and can be the cause of anterior knee pain, anterior crucial ligament, medial ligament, and meniscus injury [2, 3, 4].

Muscle skeletal modelling plays an essential role in complex biomechanical problems, and it can simulate the mechanisms of the musculoskeletal system during human motion, providing particularly useful information for trainers and physiotherapists to solve muscle skeletal problems or avoid sports injuries [3, 5].

Objective of our study is to evaluate hip muscle activity during single leg squat exercise via musculoskeletal model.

Methods

The pilot study involved one subject, a female with a height of 178 cm and weight of 87 kg. The initial position for the movement was a standing position. The single-leg squat movement was recorded using a 6 infrared cameras motion capture system (BTS P-6000, 250 Hz, BTS Bioengineering, Italy) and ground reaction force measured via 6 force plates (BTS P-6000, 500 Hz, BTS Bioengineering, Italy), with 18 markers set according to Helen Haynes using BTS Smart Analyzer and Mokka software.

The lower extremity muscle skeletal model was developed using the AnyBody Modelling System (version 7.4.4, AnyBody Technology A/S, Aalborg, Denmark) with the Plug-in-Gait Simple Lower Extremity model. Gluteus medius and tensor fascia latae muscles activities were calculated during the movement. The results were processed and analyzed using MATLAB software.

Results

Figure 1 presents the results for the single-leg squat movement. The maximum value of knee flexion during the descending squat phase was 71 degrees. Gluteus medius and tensor fascia latae muscles showed increased activity during the middle squat phase.

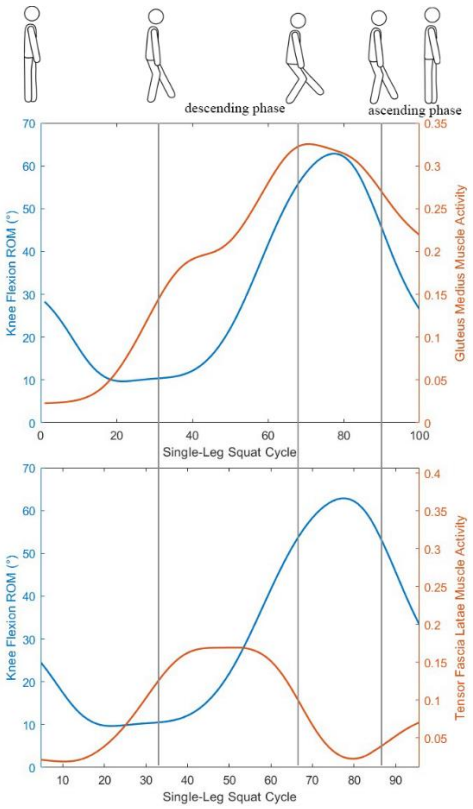


Figure 1: Hip muscles activity during single leg squat on dominated limb.

The maximum activity of the gluteus medius muscle occurred at 32% of the descent squat phase, while for the Tensor Fascia Latae muscle, it occurred at 17%.

Discussion

Analyzing results presented in Figure 1 differences between the muscle activity can be noticed. In the case of a single leg squat, higher activity of gluteus medius was observed especially at the middle phase of the squat cycle, which suggests that this muscle worked more compared to the tensor fascia latae muscle.

Summarizing, muscle activation patterns during functional movements can be analyzed and useful for creating personalized musculoskeletal models enhancing biomechanical understanding, optimizing rehabilitation strategies, and improving individualized training programs to enhance overall physical performance and prevent potential musculoskeletal injuries.

References

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