The Effect of Quadricep Femoris and Gluteus Medius Strength on the Star Excursion Balance Test (SEBT)

Background:

Star Excursion Balance Test (SEBT) is a test that measures balance and lower extremity functions, requiring neuromuscular characteristics such as coordination, strength, and flexibility in the lower extremity. The Star Excursion balance test is a dynamic test of stability that requires strength, flexibility, and balance. Compared to other balance measuring tests that are said to be "gold standard," SEBT is a reliable version, which is inexpensive, yet quick (Plisky). Studies have looked at muscle activations using the Star Excursion Balance Test for improving strength and balance, specifically targeting the gluteus medius and quadriceps femoris. The gluteus medius and quadriceps femoris are large dynamic stabilizers at the hip and knee, making these muscles important for performance and distance reach during the SEBT. However, researchers have yet considered the relationship between the muscle strength and reach distance (Earl). Thus, the purpose of this study is to analyze reach distances from subjects who performed the SEBT and compare it to muscle strength of the gluteus medius and quadriceps femoris.

Methods:

For this study, twenty-four college aged students participated in the Star Excursion Balance Test (SEBT) Validation Study. All of the subjects included in the study filled out a written consent from prior to all testing. All of the subjects were healthy and any participant with an ankle injury in the past six weeks or an impairment that would affect balance were excluded from the study. Weight and leg length (ASIS to medial malleolus) measurements were taken for all of the participants. Quadriceps and gluteus medius force readings were measured with a dynamometer. Three measurements were taken for both quadriceps and gluteus medius for each leg. The SEBT was then performed where each subject reached in three directions (anterior, posteromedial, and posterolateral) while balancing on the test leg. The subjects were instructed to reach as far as possible with the reach foot while keeping the heel of the test leg on the ground and their hands on their hips. Maximum reach was measure by having the subject touch the reach leg down onto a tape measure that was set up for each of the three directions. When the subject touched down onto the tape measure, they were instructed to not put any weight on the reach leg and return the reach leg to the starting position. Each direction was tested three times bilaterally. An average of these three trials was taken to determine the average strength of the subject as well as SEBT performance scores for each leg. The data for each test was normalized. For reach distance it was normalized to subjects' leg length, right or left depending on the test. Then for gluteus medius and quadriceps strength, data was normalized to subjects' mass (kg). A correlation was then calculated between the average strength and average reach distance of each test.

Results:

There were two trends that appeared from the data analysis. First was a positive correlation between gluteus medius strength and both posterior direction reaches. Left

posterolateral, left posteromedial, right posterolateral, and right posteromedial all showed a positive correlation to gluteus medius strength. Left posterolateral r=0.431. Left posteromedial r=0.326. Right posterolateral r=0.366. Right posteromedial r=0.251. The second trend in the data was a negative correlation between quadriceps strength and anterior reach. There was a negative correlation for both the right and left leg. Right anterior r=-0.486. Left anterior r=-0.259. The data also showed that there was little to no correlation between gluteus medius strength and anterior reach distance as well as quadriceps strength and posterior reach distance.

Discussion and Conclusion:

From this study, there showed a moderate correlation between quadriceps and gluteus medius strength for the different SEBT reaches. The positive correlation between gluteus medius strength and posterior reaches suggests that stronger proximal stabilizers on the posterior side allow for further reaches in the same posterior direction. The negative correlation between quadriceps strength and anterior reach suggests that subjects with stronger quads probably have less flexibility, affecting their anterior reach distance negatively. To conclude, quadriceps and gluteus medius strength are significant when evaluating SEBT performance.

References:

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