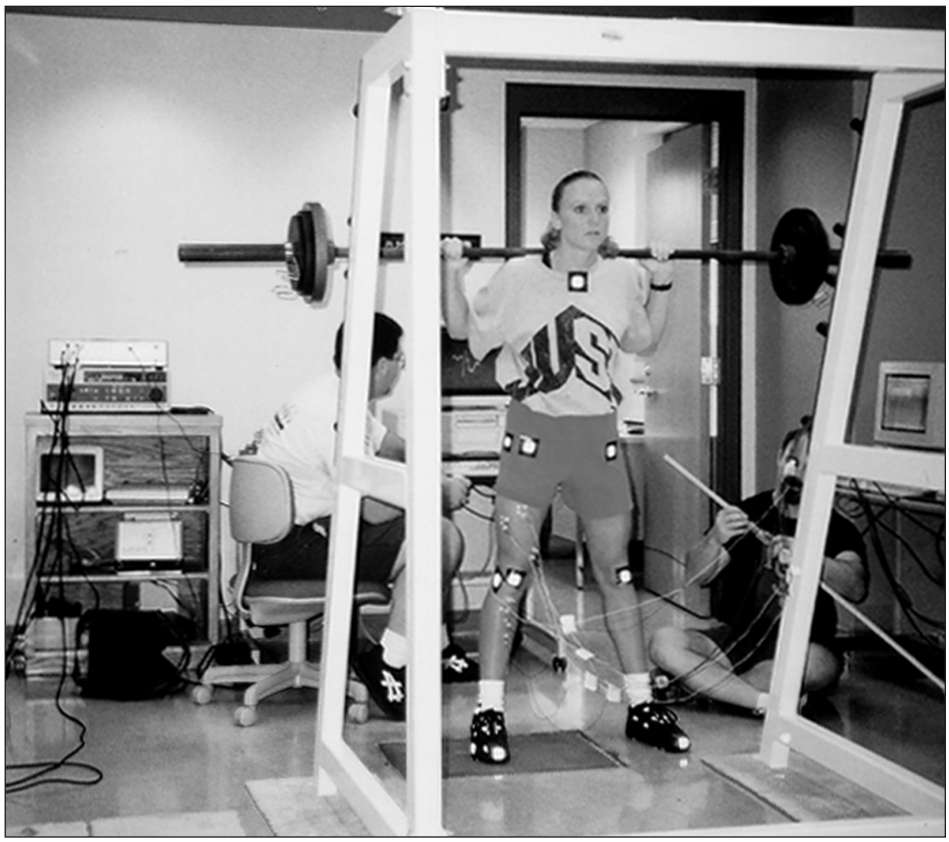
N A T A
RESEARCH & EDUCATION FOUNDATION

Grant Information Summary:

The effects of knee joint ROM and load on EMG and joint reaction force characteristics during a selected closed chain exercise

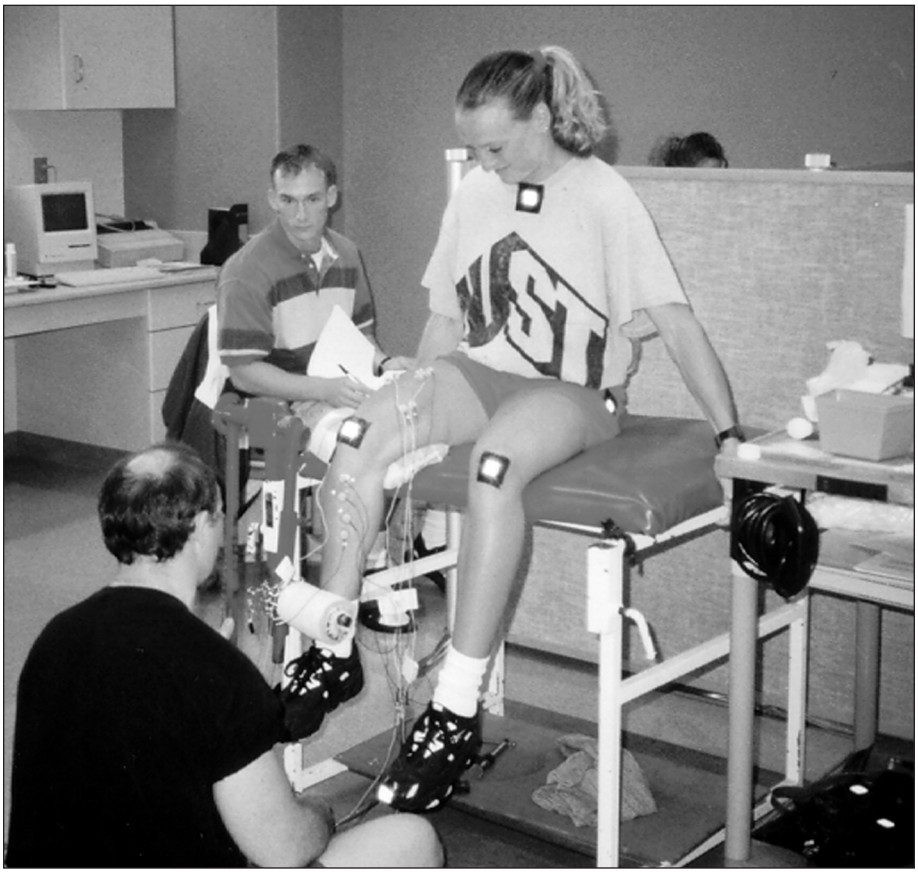
Practical Recommendations

The significance of this study is that co-contraction of the hamstrings and quadriceps is directly proportional to load and knee joint position. In addition, it appears that there is a greater imbalance of quadriceps and hamstring activity with increased resistance during the squat. Important consideration should be given to knee joint position and amount of resistance during the squat during knee rehabilitation.



Background

Closed kinetic chain (CKC) exercises are preferred in many lower extremity rehabilitation programs. This is primarily due to the fact that less shear forces are applied across the knee. Furthermore, CKC exercise allows co-contraction of quadriceps and hamstring muscles. Often, joint range of motion and the amount of external resistance applied is manipulated depending on what the capabilities of the patient are, and the therapeutic objectives. It has been shown that CKC exercise increases co-activation of the quadriceps and hamstring muscles. However, the degree to which external resistance and knee joint position affect thigh musculature and internal joint forces has not been well studied. The focus of this investigation was to evaluate the effects of external load and joint position on the EMG activity of quadriceps and hamstrings and joint reaction forces during a squat.



Results

The results of this study showed that the EMG activity (% of maximum voluntary contraction) of the vastus medialis is not load or joint dependent during the up-phase of the squat. During the eccentric phase of the squat, EMG activity was the greatest during 75% load at 135 and 90 degrees of knee flexion. With respect to the vastus lateralis and rectus femoris muscles, greatest activity was found at 135 degrees, under all loads for both the concentric and eccentric phases of the squat. Biceps femoris EMG activity during the concentric and eccentric phases of the squat did not demonstrate to be load or joint position dependent. Analysis of the ground reaction force data revealed that the shear forces created are greatest at depths of 90 and 135 degrees at a 75% load during both phases of the squat. Overall, these data indicate that hamstring muscle activity is not dependent on load or knee joint position. Conversely, quadriceps muscle activity is proportional to joint position and load.

In-Depth Analysis

Twenty healthy female student-athlete volunteers served as subjects. Subjects had surface electrodes placed over the vastus medialis, vastus lateralis, rectus femoris and biceps femoris muscles of the dominant leg. Maximum EMG activity of each muscle was recorded and normalized to a percentage of the maximum voluntary contraction. Each subject was evaluated during the concentric and eccentric phase of the squat exercise under three different external loads (0, 50%, and 75% of maximum lift) at three knee joint positions (135, 90 and 75 degrees). Ground reaction forces were also sampled during the squat exercise to determine the shear force under each condition. All conditions were performed in a counterbalanced order. Repeated measures ANOVAs were used to evaluate differences across all levels of both factors on the EMG and ground reaction force data. ■

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For further information:

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