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Original Research

A Biomechanical Investigation of A Single-Limb Squat: Implications for Lower Extremity Rehabilitation Exercise

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Abstract

Context: Single-limb squats on a decline angle have been suggested as a rehabilitative intervention to target the knee extensors. Investigators, however, have presented very little empirical research in which they have documented the biomechanics of these exercises or have determined the optimum angle of decline used.

Objective: To determine the involvement of the gastrocnemius and rectus femoris muscles and the external ankle and knee joint moments at 60° of knee flexion while performing a single-limb squat at different decline angles.

Design: Participants acted as their own controls in a repeated-measures design.

Patients or Other Participants: We recruited 10 participants who had no pain, injury, or neurologic disorder.

Intervention(s): Participants performed single-limb squats at different decline angles.

Main Outcome Measure(s): Angle-specific knee and ankle moments were calculated at 60° of knee flexion. Angle-specific electromyography (EMG) activity was calculated at 60° of knee flexion. Integrated EMG also was calculated to determine the level of muscle activity over the entire squat.

Results: An increase was seen in the knee moments ($P < .05$) and integrated EMG in the rectus femoris ($P < .001$) as the decline angle increased. A decrease was seen in the ankle moments as the decline angle increased ($P = .001$), but EMG activity in the gastrocnemius increased between 16° and 24° ($P = .018$).

Conclusions: As the decline angle increased, the knee extensor moment and EMG activity increased. As the decline angle increased, the ankle plantar-flexor moments decreased; however, an increase in the EMG activity was seen with the

Volume 43, Issue 5 (September/October 2008)

< Previous Next >

Current Issue
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24° decline angle compared with the 16° decline angle. This indicates that decline squats at an angle greater than 16° may not reduce passive calf tension, as was suggested previously, and may provide no mechanical advantage for the knee.

Keywords: knee moments, electromyography, movement analysis

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top