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# NEUROMUSCULAR COMPARISON OF THE UPPER-LEG DURING ISOMETRIC BED EXERCISES AND FUNCTIONAL SIT-TO-STAND EXERCISES IN OLDER ADULTS

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**Purpose:** Rehabilitation following hip-replacement surgery routinely includes bed exercises. However, bed exercises appear to have little impact on pain, hip motion, strength and functional mobility. Sitstanding is a pre-requisite for mobilisation and discharge, involving: asymmetrical weight-bearing, stability and concentric-eccentric contractions of the hip muscles. Therefore, sit-stands instead of bed exercises may be a preferential exercise to perform in the hours after hip replacement surgery. The study purpose was to compare hip (gluteus maximus [GM], medius [GMd]) and thigh (rectus femoris [RF], vastus medialis [VM], biceps femoris [BF]) muscle activation during isometric bed exercises and sit-stands in older adults.

**Methods:** Twenty-four, older adults (16 female, 65 þ 7 years, 79.4 þ 13.4 kg, 168.7 þ 8.7 cm) performed in random-order: 4 isometric bed exercises and sit-stand exercises during one visit. Bed exercises involved submaximal static contractions of the gluteal, abductor, quadriceps and inner range quadriceps muscles when lying supine. Each was contracted for 5 s, repeated 10 times, and 60 s rest periods separated each bed exercise. Sit-stands involved rising from a chair (height 46 cm) to an upright position (sit-stand), and then returning to a seated position (stand-sit). Instruction was given to repeat as many times possible within 30 s. Electromyography (EMG) signals were recorded (1000 Hz) from the non-dominant leg RF, VM, BF, GM and GMd via a Biometrics PS850 system (DataLOG, Biometrics Ltd., Newport, UK). For each muscle, EMG signals were processed as root mean square (RMS); peak amplitude was selected from a 1 s epoch during bed and sit-stand exercises (DataLOG software v. 7.5, Biometrics Ltd., Newport, UK). RMS signals were normalized to peak amplitude recorded from isometric maximal voluntary contractions (MVC). Analysis was separate for standing and sitting phases and averaged over the middle three movements. One way, Friedman's repeated measures analysis of variance (ANOVA) was used to identify differences between RMS amplitudes during bed and sit-stand exercises for each muscle. Paired Wilcoxon Signed-Rank tests identified differences between contractions and sit-stands ($p < 0.05$).

**Results:** Muscle activation ranged from: 2.4-60% MVC for bed exercises and 54-81% MVC for sit-stands (quadriceps); 9.8-20% for bed exercises and 27-45% MVC for sit-stands (hamstrings); and 9.8-44% MVC for bed exercises and 34-59% MVC for sit-stands (gluteals). RF activity was higher during sit-stands, than inner range quadriceps contractions (by 29%; p ¼ 0.006), but similar with other bed exercises. VM activity was higher during sit-stands ($p < 0.0001$), than isometric gluteal (by 65%; $p < 0.0001$), abductor (by 60%; $p < 0.0001$) and inner range quadriceps bed exercises (by 36%; $p < 0.0005$). VM activation was higher when

chair rising, than sitting ($p < 0.0001$). BF activity was higher during sitstands ($p < 0.0001$), than isometric gluteal (by 29%; p ¼ 0.01), abductor (by 36%; $p < 0.0001$), inner range quadriceps (by 34%; $p < 0.0001$) and quadriceps bed exercises (by 24; p ¼ 0.04). GM activity was higher during sit-stands ($p < 0.0001$), than isometric abductor (by 46%; $p < 0.0001$), inner range quadriceps (by 50%; $p < 0.0001$) and quadriceps bed exercises (by 44%; $p < 0.0001$). GMd activity was higher during sitstands ($p < 0.0001$), than isometric inner range quadriceps (by 30%; $p < 0.0001$) and quadriceps bed exercises (by 22%; p ¼ 0.01). GMd activation was higher when chair rising, than sitting (by 19%; p ¼ 0.03).

**Conclusions:** Hip and thigh muscles were activated differently between isometric bed and sit-stand exercises. Greatest activation was seen in the chair rising element of sit-stand. For no bed exercise did muscle activity exceed that required to sit-stand. Hamstrings (BF) activation failed to exceed 40% MVC (from 9-15%) for bed exercises, yet hip and thigh muscle activity was at least 45% MVC for sit-stands. For only sitstands were all muscles were activated over 40%; the level required to stimulate muscle strength adaptation. Lower activation for sitting, than standing, was likely due to a lesser requirement for motor unit activity for eccentric actions of the quadriceps and gluteals. It is possible that these exercises could evoke higher activation amplitudes in patients recovering from hip replacement and future work will examine muscle activity for bed and sit-stand exercises in this clinical population. If similar results are found, practice could change to replace bed exercises with sit-stand and other.