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Title:

Functional sit-to-stand exercises evoke greater neuromuscular activation, than isometric bed exercises in community-dwelling, older adults

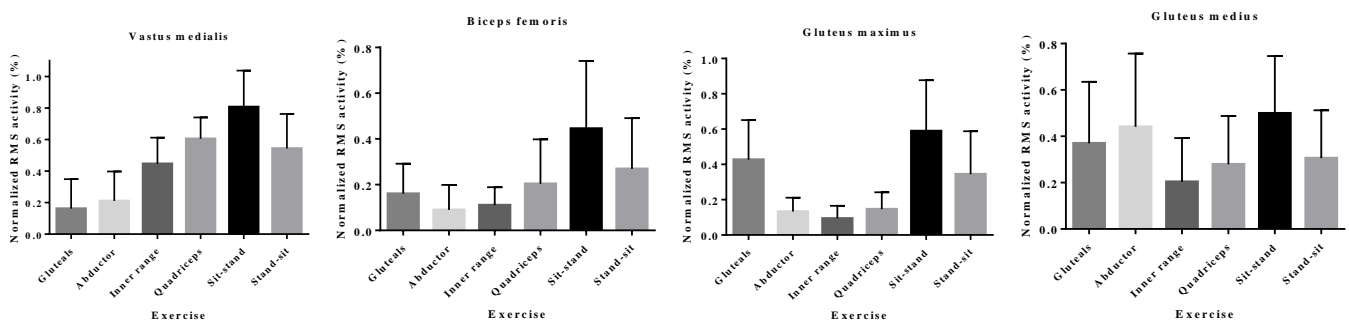
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Introduction: Rehabilitation after hip-replacement surgery routinely includes isometric bed exercises. However, these have little impact on pain, hip motion, strength and functional mobility [1]. Sit-standing is required for mobilisation and discharge, involving: asymmetrical weight-bearing, stability and concentric-eccentric hip muscle contractions. Therefore, sit-stands may be a preferential exercise to bed exercises in the hours after hip-replacement surgery.

Research Question: Is muscle activation of the hip and thigh muscles greater during isometric bed exercises, than sit-stands in older adults?

Methods: 24 participants performed: isometric bed exercises and sit-stand exercises (random-order) on one occasion. Bed exercises were ten submaximal contractions (each 5 s) separately for gluteal, abductor, quadriceps and inner range quadriceps muscles (60 s rests). Sit-stands involved chair rising to an upright position (sit-stand), then returning to a seated position (stand-sit) as many times possible within 30 s. Electromyograms (EMG) were recorded from the rectus femoris, vastus medialis, gluteus medius, biceps femoris and gluteus maximus, via a Biometrics PS850 system, during exercises. Signals were normalised to % of isometric maximal voluntary contraction, with separate analysis for standing and sitting phases. One-way, Friedman's repeated measures ANOVA identified activation differences between each muscle during exercise modes. Paired Wilcoxon Signed-Rank tests located specific activation differences.

Results: Quadriceps activation ranged from: 2-60% for bed exercises and 54-81% for sit-stands (quadriceps); 10-20% for bed exercises and 27-45% for sit-stands (hamstrings); 10-44% for bed exercises and 34-59% for sit-stands (gluteals). Vastus medialis activation was greater sit-standing, than gluteal (by 65%; $p<0.0001$), abductor (by 60%; $p<0.0001$) and inner range quadriceps bed exercises (by 36%; $p<0.0005$). Biceps femoris activation was greater sit-standing, than gluteal (by 29%; $p=0.01$), abductor (by 36%; $p<0.0001$), inner range quadriceps (by 34%; $p<0.0001$) and quadriceps bed exercises (by 24%; $p=0.04$). Gluteus maximus activation was greater sit-standing, abductor (by 46%; $p<0.0001$), inner range quadriceps (by 50%; $p<0.0001$) and quadriceps bed exercises (by 44%; $p<0.0001$). Gluteus medius activation was greater sit-standing, than inner range quadriceps (by 30%; $p<0.0001$) and quadriceps bed exercises (by 22%; $p=0.01$); chair rising activation exceeded sitting activation (by 19%; $p=0.03$).



Discussion: Hip and thigh muscles were activated differently between isometric bed and sit-stand exercises, with rising during the sit-stand requiring greatest activation. For no bed exercise did muscle activity exceed that required to chair rise. All muscles were activated over 40% only for sit-stands; the level required stimulating muscle strength adaptation [2]. A larger, subsequent study will examine these observations in patients recovering from total hip-replacement surgery, and determine functionally how they relate to gait performance and balance. If similar results are found, practice could change to replace bed exercises with sit-stands and other functional exercises in the acute recovery after surgery.

References: [1] Smith et al, Physiotherapy 2008; 94(4):286-291 [2] Andersen et al, Phys Ther 2006;86(5):683-69