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TRUNK MUSCLE FORCES AND SPINAL LOADS DURING SIT-TO-STAND AND STAND-TO-SIT ACTIVITIES: DIFFERENCES BETWEEN PERSONS WITH AND WITHOUT UNILATERAL TRANSFEMORAL AMPUTATION

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Summary: Low back pain (LBP) is a significant secondary health problem in persons with unilateral lower limb amputation. In particular, persons with versus without transfemoral amputation (TFA) often adopt different trunk postures/motions when performing activities of daily living to overcome the physical limitation(s) imposed by amputation. Such differences in trunk postures/motions, if associated with even moderate increases in spinal loads across all activities of daily living, can lead to LBP via cumulative damages in spinal tissues. The objective of this study was to compare spinal loads between persons with (n=10) and without (n=10) TFA when performing sit-to-stand and stand-to-sit activities. A non-linear finite element model of the lumbar spine and trunk muscles, adjusted for participant height and weight, was used to calculate trunk muscle forces and the resultant spinal loads. Model inputs were kinematics of thorax and pelvis measured when participants performed sit-to-stand and stand-to-sit activities. Forces within superficial muscles (attached between pelvis and thorax spine) were 145 N larger* in person with versus without TFA, while forces within deeper muscles (attached between pelvis and lumbar spine) were 57 N larger during stand-to-sit versus sit-to-stand. The resultant mean and peak values of compression force at L5-S1 were respectively 171 N (~12%) and 348 N (~16%) larger in persons with TFA. The maximum value of anterior-posterior shear force at L5-S1 was also 217 N (~24%) larger in persons with TFA. Finally, in persons with TFA the mean and maximum values of lateral shear force at L5-S1 were respectively 68 N (~92%) and 215 N (~81%) larger during stand-to-sit versus sit-to-stand. The peak value of shear force experienced at L5-S1 (~1.1 kN) among persons with TFA during sit-to-stand was within the reported range of threshold of injury (i.e., 1-2 kN) for lumbar spine motion segments. Considering we have recently reported persons with versus without TFA experience larger spinal loads during walking, characterization of these loads during (other) activities of daily living further highlights their potential role in LBP after TFA, and may assist with the development of trunk-specific movement retraining or other preventative therapies.
*$p<0.05$ in all reported results