DETERMINATION OF THE LOWER LEG MUSCLE RESPONSES TO UNEVEN TERRAIN DURING GAIT
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Introduction: Previous studies have identified four distinct types of mechanoreceptors in the glabrous skin of humans, all of which contribute to the detection of the COP and stability under the plantar surface of the foot [1]. Further research has determined the importance of this sensory information for efficient gait and postural control, as these receptors may detect stability changes and initiate postural reflexes in order to prevent the COM from moving outside of the base of support [2][3]. A relationship has been identified between plantar pressures as detected by mechanoreceptors and muscle activity in the leg [4], however further investigation is required to understand whether a direct link exists between plantar pressure changes under specific areas of the foot and any subsequent muscle responses during gait. As the first step in the process, the leg muscle responses to uneven terrain are presented here.

Methods: Kinetic and kinematic data was collected from 19 healthy participants aged 18-28 (mean=22.3, SD=3.41) all without any musculoskeletal, vestibular or sensory conditions that may have influenced balance control. Each participant completed 10 normal walking trials, and 20 perturbed gait trials. Wooden wedges were placed on two floor-embedded force plates within each subject’s stepping pattern to mimic four uneven terrain conditions, allowing us to record both anterior-posterior and medial-lateral perturbations. Each participant was equipped with electromyographical equipment to record muscle activity from 8 muscles of the right and left legs. Participants were fit with standardized shoes, each containing a size-matched pressure sensor to measure changes in pressure distribution during each condition.

Results: Analysis of the five terrain conditions revealed significantly higher muscle activity magnitude in conditions 1 (mean=236.2uV), 2 (mean=241uV) and 4 (mean=234uV) than in normal walking (mean=178.5uV) and condition 3 (mean=158.3uV) (F(4,3267)=10.97, p<0.05). Further analysis showed significantly longer bursts of muscle activity during condition 1 (mean=19.15ms) than in normal walking (mean=16.46ms) (F(4,3267)=4.098, p<0.05). Analysis of each of the eight muscles revealed many trends, indicating high rates of situational muscle behaviour. In reference to the lower leg, the right tibialis anterior (RTA) (mean=20.9ms) showed significantly faster onset times following heel contact than the right peroneus longus (RPL) (mean=123.2ms) and medial gastrocnemius (RMG) (mean=83.1ms) (F(7,3267)=5740, p<0.05).

When considering the upper leg, results show significantly higher magnitudes of muscle activity in the anterior right rectus femoris (RRF) (mean=308.1uV) than in the posterior muscles, right biceps femoris (RBF) (mean=131.5uV) and right gluteus maximus (RGM) (mean=161.7uV) (F(7,3267)=84.07, p<0.05).

Discussion & Conclusion: This preliminary analysis has outlined some of the effects of uneven terrain on muscle activity in the leg. It is clear that differing terrain conditions can influence our muscular response during gait, however further analysis will be completed to identify whether these altered muscular responses are correlated with changes in plantar pressure patterns during uneven terrain walking.