ACL Deficient Non-copers Reduce Co-contraction Values During Gait after Perturbation Training

Hartigan, E; Snyder-Mackler L
University of Delaware, Newark, DE
Senior author: smack@udel.edu

Introduction
A differential compensatory response occurs soon after ACL rupture with potential copers utilizing greater dynamic knee stability compared to non-copers. Potential copers demonstrate a greater likelihood of successfully returning to sports after receiving a pre-operative intervention paradigm that includes perturbation training (Fitzgerald et al., 2000). After perturbation training, potential copers alter muscle activity resulting in reduced co-contraction values between agonist and antagonist muscle pairs in the involved limb during gait (Chmielewski et al., 2005). While non-copers also initially present with higher involved limb co-contraction values (Rudolph et al., 2001) their response to perturbation training is unknown.

Purpose
Our purpose is to determine whether non-copers demonstrate a greater reduction in co-contraction values after perturbation training in conjunction with strength training on the involved limb compared to a group who receives only strength training. Secondly, we will test whether these changes are maintained six months after ACL reconstruction.

Hypotheses
EMG muscle co-contraction values in the involved knee during the weight acceptance and mid-stance phases of gait in the Perturbation group will improve over time, whereas the Strength group’s values will not change over time (pre-intervention, post-intervention, 6 months following ACL reconstruction).

Methods
Non-copers were recruited and randomized into two groups to receive 10 pre-operative physical therapy sessions: progressive strength training (STR=15) and perturbation training in conjunction with progressive strength training (PERT=15). Subjects completed three (pre-intervention, post-intervention, 6 months post-operative) motion analysis testing sessions where co-contraction values were obtained during gait (VM=vastus medialis; VL=vastus lateralis; LH=lateral hamstring; MH=medial hamstring; MG=medial gastrocnemius; LG=lateral gastrocnemius) (Rudolph et al., 2001). An ANOVA with one repeated measure (time) was used to compare differences in co-contraction in the involved limb during the weight acceptance and mid-stance phases of gait for the PERT and STR groups. Paired t-tests were used as post-hoc tests if significance was found. Significance is set at p ≤ 0.10 due to the highly variable nature of EMG (Winter et al., 1995).

Results
During the weight acceptance phase of gait, the ANOVAs determined that the involved limb VL LH (PERT: p=0.163; STR: p=0.620) and VLLG (PERT: p=0.601; STR: p=0.235) co-contraction indexes did not change over time for either group (Fig 1). The VMMH and VMMG pairs did decrease in the PERT group (p=0.010; p=0.051 respectively), whereas the STR group did not demonstrate changes in co-contraction values for these pairs over time (p=0.671; p=0.153 respectively). Paired t-tests indicated that co-contraction values in the VMMH pair significantly increased from pre-intervention to post-surgery (p=0.083) and significantly decreased in the VMMG pair from pre-intervention to post intervention in the PERT group (p=0.016). During the mid-stance phase of gait, ANOVAs determined that there was a significant difference in involved VLLH, VLLG, and VMMG co-contraction values over time in the PERT group (p=0.097, p=0.051, and p=0.024, respectively). Paired t-test indicated that the reduction in co-contraction values occurred from pre-intervention to post-intervention for the VLLH, VLLG, and VMMG muscle pairs (p=0.053, 0.002, p=0.016 respectively). There were also changes over time in the VLLH and VMMG muscle co-contraction pairs in the STR group (p=0.057, p=0.080 respectively). Paired t-tests denoted that the

Discussion
Non-copers demonstrate the ability to modify neuromuscular strategies after pre-operative therapy to a greater extent in the group who received perturbation training. All significant reductions were maintained when tested six months after ACL reconstruction. The large variability in co-contraction values suggests that individual EMG data needs to be explored as non-copers may be demonstrating different responses within the groups, especially after surgery.

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