Towing a Weighted Sled is an Effective Way to Increase Knee Moments after ACL Reconstruction

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Context: Reduced internal knee extension moments are predictive of re-injury and the inability to pass criteria deemed necessary to return to sports after anterior cruciate ligament reconstruction (ACLR). Yet after rehabilitation and ACLR, athletes do not appear to utilize strength gains as reduced knee moments in the ACLR limb exist during walking, running, and jumping. Towing a weighted sled increases knee moments in healthy athletes and may increase knee moments post ACLR. Objective: We hypothesize that towing a weighted sled will generate greater knee moment impulses than walking normally in subjects who have undergone ACLR. Design: Experimental repeated measures design. Setting: University of New England’s Biomechanics Laboratory. Subjects: A power analysis using knee moment data from healthy athletes’ walking normally [6.09 Nms/kg (2.6)] and towing a weighted sled (6.96 Nms/kg), an alpha error level of 5% and beta error level of 20% indicated that six subjects were needed. A sample of convenience was used to recruit six subjects (sex: 4F, 2M; age: 19.7±3.1 years; height: 1.7±0.6 m; mass: 73.3±12.5 kg who were 5-12 months post ACLR, discharged from physical therapy, and cleared by their surgeon to return to sport and participate in the study. Interventions: Standard motion capture practices using an 8 camera 3D motion analysis system (Qualysis, Sweden) and three multi-axis force plates (AMTI, MA) were used to collect five usable motion trials. Subjects completed normal walking and walking while towing a weighted sled (20% body weight) attached at the waist. Walking speed was maintained at 1.3 m/s ± 5%. Main Outcome Measures: Knee joint moments in the ACLR limb were calculated using inverse dynamics. Knee extension moment impulses (force over time) were calculated using a custom written MATLAB code (MathWorks, MA) over the stance phase of gait. Results: Knee moment impulses during walking [(3.98 Nms/kg (+3.65)] and towing a weighted sled [(5.69 Nms/kg (+3.62)] were compared. The paired t-test showed that towing the weighted sled significantly increased knee moment impulses compared to walking [change score of 1.72 Nms/kg (95% Confidence Interval: 2.93 to 0.50)] (p=0.015). Conclusions: Towing a weighted sled with resistance as low as 20% body weight produced a large magnitude of change indicating that this task is an effective way to challenge knee moments after ACLR. Since net knee moments infer muscle forces, greater knee extensor strength is required during this dynamic, functional, low-impact, sports-simulated towing activity. Word Count: 431