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4.3 - BIPEDAL PERILS FOR PATIENTS: PEAK BRAKING AND PROPULSIVE FORCES IN GRADIENT WALKING

Saturday, February 15, 2020
9:44 AM - 9:51 AM

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Summary

Background: Protecting a healing injury to the lower extremity often requires limiting the forces applied through ambulation. Lower extremity postoperative patients navigate a wide variety of terrains and obstacles once they regain mobility but are still in recovery. These terrains influence the peak braking and propulsive ground reaction forces (GRFs) and pressure distribution across the footbed over multiple gait cycles, but this information that is crucial to patient recovery is relatively unexplored. Most biomechanical and kinematic walking studies have been constrained to the laboratory or to track setups. These protocols do not fully capture the adaptations humans make for the surfaces they traverse outside of laboratory environs, particularly on sloped surfaces such as ramps, which lower-extremity postoperative patients often prefer as an accessible alternative to stairs. Before work can be undertaken using postoperative patients, understanding the effect of gradient on forces in control subjects is imperative. **Methods**: The data were collected from eleven participants aged 20 to 42 years without gait pathology or injury. Each participant was fitted to a pair of wireless pressure-sensing insoles with an array of force sensors distributed across each insole surface. Participants were asked to walk on a treadmill at 0.89m/s, 1.34m/s, and 1.79m/s for 60 seconds at each velocity, as well as on a treadmill set to a 10% slope at 0.89m/s. Participants then walked along a straight, flat, 78.4 meter indoor walkway and in a straight line on an outdoor sidewalk downhill and uphill 70.5 meters over an 8.75% slope. We analyzed 6711 steps total. **Results**: We found that peak braking and propulsive GRFs differ significantly between surface types and walking speeds when we control for participant mass and velocity, and downhill walking results in significantly higher peak braking forces than any other tested walking condition, including fast (1.79m/s) walking when we control for velocity ($p<0.001$). **Conclusions**: It is imperative for the improvement of patient rehabilitation protocols that we understand the peak GRFs that occur when a patient is regaining mobility. Ramps are usually suggested as the preferred alternative to stairs during patient recovery, but the forces generated on inclines and declines should not be discounted as negligible during recovery. Patients already struggle to maintain consistency and adherence to postoperative protocols on flat surfaces, gradients could have an unexplored impact on recovery as well.

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