

**PATHOKINESIOLOGY LABORATORY
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ABSTRACTS FROM CONFERENCE PRESENTATIONS (2003 – 2005)

Effect of lower extremity torque on vertical shoulder joint force during walking with assistive devices in persons with incomplete spinal cord injury. Gutierrez DD, Lighthall Haubert L, Newsam CJ, Gronley JK, Mulroy SJ, Perry J. Combined Sections Meeting of the American Physical Therapy Association: February 2003, Tampa, FL

PURPOSE: To define the relationship between lower extremity (LE) isometric torque and the vertical component of the shoulder joint reaction force during ambulation with crutches (CR) and a walker (WKR) in persons with incomplete spinal cord injury (SCI).

SUBJECTS: Six persons with incomplete SCI participated (3 tetraplegia, 3 paraplegia). Subjects were greater than one year post SCI, able to walk 50 feet, and asymptomatic for upper extremity pain.

METHODS: Subjects ambulated at a self-selected velocity using forearm CR and a front-wheeled WKR instrumented with 3D load cells that recorded forces applied to the assistive device during ambulation. Bilateral upper extremity (UE) kinematics were measured with a VICON motion analysis system. LE isometric torque was measured bilaterally at the ankle, knee and hip using a LIDO dynamometer and ring tensiometer.

ANALYSIS: An inverse dynamics approach was used to calculate the UE moments and forces. The vertical component of the shoulder joint reaction force was determined for the UE contralateral to the weaker LE. Peak vertical shoulder joint reaction force and walking velocity were compared between the 2 assistive devices using a paired t-test. Stepwise regression analysis was used to determine the association between LE isometric torque and the peak vertical shoulder force.

RESULTS: Mean self-selected walking velocity was slightly reduced during ambulation with CR (40% of normal) compared with velocity during the WKR condition (45% of normal; $p=.29$). Peak vertical shoulder joint force during ambulation with the CR (mean=45N, +/- 40) was 50% greater than peak force with the WKR (mean=31N, +/- 29; $p=.16$). Statistical power analysis revealed an effect size of 0.52 for the difference in vertical shoulder joint force and determined that 31 subjects would be necessary to achieve significance (80% power). Mean LE torque ranged from 24% of normal (plantar flexion) to 43% of normal (dorsiflexion). Stepwise regression analysis revealed that combined contralateral hip abductor and knee extensor torque was a significant predictor of vertical shoulder joint forces during ambulation with a WKR ($r^2 = .77$; $r = -.88$). The strongest predictor of vertical shoulder joint force during CR ambulation was contralateral hip and knee extensor torque ($r = -.69$), however the regression analysis did not reach statistical significance.

CONCLUSION: Crutch ambulation was slower and produced a greater vertical shoulder joint force, although not statistically significant with these preliminary data. During ambulation with a WKR, reduced strength of the contralateral hip abductors and knee extensors was associated with increased vertical shoulder joint force.

RELEVANCE: Increased UE demand following SCI contributes to a high incidence of shoulder pathology. To minimize the risk for impingement of subacromial structures, the impact of LE strength on shoulder joint forces and the ability of the UE to meet these imposed demands should be considered when selecting an assistive device.

Acknowledgement: Funded by National Institute of Health (#HD37544-02)
