Age related differences in shoulder joint biomechanics during manual wheelchair propulsion

A Symonds; S Taylor; P Smitham; C Holloway

University College London Institute of Orthopaedics and Musculoskeletal Science, London, United Kingdom

Introduction and Aims

There is a high incidence of shoulder pain in manual wheelchair users that has been associated with increasing age and duration of wheelchair use. With increasing age, the shoulder joint is more prone to injury due to the biomechanical changes commonly caused by rotator cuff muscle degeneration.

The aim of this study was to quantify biomechanical differences between younger and older participants during manual wheelchair propulsion. It was hypothesised that the older group would demonstrate kinetic differences (increased push rate and reduced push efficiency) and kinematic differences (increased change of inclination angle of the humerus and increased relative muscle activity) from the younger group.

Material and Methods

Two groups of 5 participants (younger and older) with no previous experience pushing a wheelchair completed a pushing test on a wheelchair ergometer. During the test, force imparted at the push rim was measured using the Sensewheel, an instrumented wheelchair wheel measuring with 6 degrees of freedom. The TrignoTM Electromyography system was used to record change in inclination of the humerus and shoulder joint muscle activity.

Results

The results demonstrated no significant difference between the groups in the kinetic parameters measured. The older group demonstrated a larger change in inclination of the humerus during the test, significantly so in the frontal plane ($P = 0.05$). Although not statistically significant, the older group demonstrated higher muscle activity during the test, particularly for the Anterior Deltoid and Infraspinatus muscles. Baseline external rotation muscle strength was strongly associated with normalised Infraspinatus muscle activity during the test across both groups ($P = 0.04$).

Conclusion

The older group achieved similar kinetic output as the younger group during the wheelchair test. To achieve this required a larger change in inclination angle of the humerus and greater normalised muscle activity around the shoulder. The demonstrated kinematic differences theoretically predispose the older group to shoulder injury during manual wheelchair propulsion.