MECHANICAL LOAD IN THE SHOULDER DURING WHEELCHAIR-RELATED ACTIVITIES

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INTRODUCTION

The upper extremities are at serious risk in hand rim wheelchair users. Several researchers (Curtis et al., 1999, Pentland & Twomey, 1994) have shown that upper-extremity complaints frequently occur within the wheelchair user population. This is likely related to wheelchair propulsion, but possibly even more to other wheelchair related tasks such as transfers and weight relief lifts.

One of the factors that may contribute to these complains is the high mechanical load on the shoulder joints. Research has shown that the mechanical load on the shoulder during propulsion on a wheelchair-ergometer (Veeger et al., 2002) is considerable and possibly harmful, but is not as high as the load reported for other daily life activities such as coming from sit to stand in able-bodied individuals (Anglin et al., 2000. It is therefore suggested that wheelchair-related daily activities can result in higher peak mechanical loads on (especially) the shoulder compared to mere wheelchair propulsion. Physiological research on people with a spinal cord injury has shown that activities such as making a transfer provoked high levels of strain (Janssen et al., 1994). The effect of paralysis of shoulder and thorax muscles on the mechanical load could be substantial but has not been quantified yet.

The aim of this study is to quantify the internal mechanical load on the shoulder during wheelchair-related activities for a group of able-bodied subjects and to collect data for future comparison with subjects with a spinal cord injury.

METHODS

Six able-bodied male subjects (body mass: 81.7 ± 11.3 kg) participated on a voluntary basis. All subjects performed 11 tasks, including others wheelchair propulsion (0.83 m/s), and weight relief lifting (figure 1). Three-dimensional (3D) kinematics of the thorax, scapula, humerus, forearm and hand were measured with a 50-Hz digital video. A 6-degrees of freedom instrumented wheel (figure 2) measured 3D forces and moments. Position and force data were used as input for the Delft Shoulder and Elbow Model (Helm, 1997), which calculates muscle forces and joint reaction forces.

RESULTS AND DISCUSSION

Preliminary data show that peak mechanical loads (joint reaction forces) during wheelchair propulsion at normal velocity were between 600 and 800 N. The loads in the present study were comparable to values calculated by Veeger et al. (2002) for propulsion on a wheelchair ergometer.

REFERENCES