SHOULDER MUSCLE ACTIVITY DIFFERS BETWEEN FORWARD AND REVERSE WHEELCHAIR PROPULSION
– AN EXPERIMENTAL STUDY OF THE IMPACT OF A NOVEL WHEELCHAIR DRIVING DEVICE

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Introduction
Wheelchair propulsion increases independent mobility in disabled. Conventional wheelchairs propelled by manual application of forward/downward directed force results in high incidence of shoulder and neck pain. The underlying mechanisms remain relatively unexplored, but muscle fatigue and biomechanics during high repetitive load is considered to play a major role. A novel device was developed to allow forward wheelchair propulsion by pulling as well as pushing the hand rim.

This study explored the shoulder muscle activity by surface electromyography measurements during push and pull tasks in a wheelchair in a laboratory setting.

Methods – analysis
Video recordings of last to first rim contact defined propulsion phases. Raw propulsion phase EMG data was filtered, full-wave rectified and smoothed before MVC normalization and calculation of mean and peak RMS-EMG (RMS-EMG). No statistical differences were observed between the groups that were pooled into one group before comparison of mean and peak RMS-EMG between the two tasks by repeated measures ANOVA (RM-ANOVA) and post-hoc t-tests.

Results – supplementary
Visual inspection of normalized RMS-EMG data across the participants revealed reverse muscle activity during the propulsion phase during pulling compared with pushing tasks (Fig. 4.)

Conclusion
The use of an innovative device effectively allowed the participants to drive a wheelchair forwards by pushing and pulling. The two tasks resulted in significant differences in shoulder and upper extremity muscle activity. This may decrease the risk of overuse injuries in wheelchair users but more research is needed to explore this.

Discussion
Propulsion of a wheelchair by pulling the rim backwards may be a possible motor strategy to distribute mechanical load in contractile structures in or related to the muscles. The pulling strategy, however, seems to be less effective than pushing.

More experimental and clinical research is needed to explore the underlying mechanisms in pain syndromes in wheelchair users. Other mechanical factors like seated posture and non-contractile tissue load may play a role, but the ability to use different propulsion strategies may decrease the risk of musculoskeletal pain caused by repetitive strain injuries. The short- as well as the long-term impact should be examined in future prospective studies.