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# PRELIMINARY ANALYSIS OF KINEMATICS AND MUSCLE ACTIVITY ON A NOVEL HANDLE BASED WHEELCHAIR PROPULSION MECHANISM

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**Summary:** Frequent use of push-rim wheelchairs often leads to upper extremity injuries, partly because in this propulsion technique joint excursion is not within the ergonomic ranges of human joint motion.
Kurup et al., (2017) investigated on a new propulsion technique for wheelchairs based on computational optimization of a musculoskeletal model and found a propulsion pattern which works within the anthropometric joint ranges, consequently reducing the risk of injuries.
The optimized propulsion movement was realized as a propulsion device consisting of a crank linked to a sliding guide and a handle. This propulsion mechanism with the crank joint as origin is attached to the lateral side of the wheelchair. During propulsion, the crank changes its effective length forced by the sliding guide results in the novel propulsion movement for the handle.
In this study, motion capture data and EMG data of the Biceps and Triceps muscle groups were collected from 3 healthy subjects during wheelchair propulsion with the novel mechanism at an average power output of 30W. A 7 DOF human musculoskeletal model was then used to perform an inverse kinematic simulation using the OpenSim software. The kinematic results from the model show that the joint motions were within the ergonomic ranges for all three subjects. The subjects showed a semi-circular hand propulsion pattern, which resembles the stroke pattern during push-rim propulsion [2]. Biceps and triceps muscle groups were found to be active during both pull and push phases of propulsion.
This preliminary study indicates that the novel propulsion device may help to reduce the occurrence of injuries when compared to push-rim propulsion [1] and thus improve the quality of life of wheelchair users.

**Reference:**

[1] Kurup et al (2017) Dynamically optimized muscle activity patterns from a novel handle based propulsion movement for a wheelchair. ISBS Conference Proceedings 35(1), 698-701.
[2] Kwarciak et al (2009)Redefining the Manual Wheelchair Stroke Cycle: Identification and Impact of Nonpropulsive Pushrim Contact. Arch Med Rehabil;90(1)20-26