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"Taking the next step"

Whole-body biomechanical gait analysis, and user-perspectives on robotic-assisted gait training post-stroke

Heidi Nedergård

Akademisk avhandling

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Fakultetsopponent: Professor Erika Franzén
Institutionen för Neurobiologi, Vårdvetenskap och Samhälle
Karolinska institutet, Stockholm.

Department of Community Medicine and Rehabilitation,
Physiotherapy

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Author
Heidi Nedergård

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Abstract
Identifying the most optimal evaluation methods of post-stroke gait, and developing treatments that reduce the risk of developing non-optimal compensatory movement patterns, is considered critical within post-stroke rehabilitation research. This thesis aims to contribute to the discussion on how to quantify gait movement patterns post-stroke from a whole-body perspective. It will also evaluate the experience of high-intensive and robotic-assisted gait training in persons with impaired walking ability due to stroke. A systematic review and meta-analysis consolidated the evidence for the effects of RAGT on biomechanical measures of gait in persons post-stroke. Two descriptive, cross-sectional studies based on kinematic gait data (31 persons post-stroke and 41 non-disabled controls) investigated potential variables to quantify post-stroke gait. The size and angular velocity of the inclination angles between the Centre of Mass (CoM) and the ankle or head, respectively, was investigated with curve analyses covering the whole gait cycle. Furthermore, misclassification rates were calculated based on leave-one-out cross-validation and logistic regression to address the combinations of kinematic variables that most correctly classify a person post-stroke when compared to controls. Finally, individual interviews were performed to explore the experiences of high-intensive gait training, including RAGT, among persons in the long-term post-stroke.

The systematic review and meta-analyses did generally not reveal significant differences between RAGT and comparator groups for biomechanical parameters. Risk of bias assessments raised concerns for several of the studies and the general quality of evidence for these outcomes was very low. Data from the primary cross-sectional studies indicated a bilateral lower body adaptation and unilateral upper body adaptation during walking in persons post-stroke. Furthermore, core sets of 2-3 kinematic gait variables were identified that, when combined, were most likely to differentiate post-stroke gait from gait in non-disabled controls. The qualitative analysis of participants' perspectives on high-intensive gait training including RAGT revealed four categories which described: 1) A generally positive mindset when starting the gait training intervention; 2) That engaging in a high-intensive gait training programme was appreciated although experienced as mentally and physically exhausting. The role of the physiotherapist was perceived as crucial; 3) Potential barriers during RAGT, such as discomfort and lost control during walking with the robot, but also facilitators like concrete feedback and the possibility to walk longer distances, and; 4) The participants' feelings of confidence or concern for the future.

The systematic review demonstrated a very low certainty in current evidence for employing RAGT instead of non-robotic gait training to improve gait biomechanics post-stroke and emphasized the lack of standardised guidelines as to which outcome measures most sufficiently quantify gait post-stroke. The cross-sectional studies, presenting upper and lower body kinematic variables to identify post-stroke gait patterns, highlight the advantages of adopting a whole-body perspective. Finally, interviews identified valuable aspects from the user's perspective that should be considered during further development of RAGT devices and the design of high-intensive gait rehabilitation programmes post-stroke.

Keywords
stroke, robotic-assisted, electro-mechanical, gait training, gait analysis, user-perspectives, kinematics

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