STROKE REHABILITATION: A KINEMATIC ANALYSIS OF DEVICE-ASSISTED AND CLINICIAN-ASSISTED SIT-TO-STAND TRANSFERS

[1,2]Aaron M. Hueftle, [1,2]Bradley J. Balogh, [1]Adam P. Taylor, [1]Amy J. Goldman, [1]Thad W. Buster, [1,2]Judith M. Burnfield

[1]Madonna Rehabilitation Hospital, Institute for Rehabilitation Science and Engineering, Lincoln, NE
[2]Biological Sciences and Biological Systems Engineering, University of Nebraska – Lincoln, Lincoln, NE
email: jburnfield@madonna.org, web: http://madonna.org/research_institute

INTRODUCTION

Work injuries arising from manually transferring patients during rehabilitation are concerning [1]. Although mechanical sit-to-stand transfer devices are frequently available to lessen clinician's physical effort, many rehabilitation therapists hesitate to use devices owing to concerns that device-assisted transfers may promote abnormal patient movement patterns. Our previous research documented significant differences in kinematic patterns between a device-assisted and normal sit-to-stand transfer in individuals without known pathology [2]. However, it was unclear from this work whether a clinician-assisted transfer would more closely simulate "normal" movement than a device-assisted transfer when patient weakness and movement control problems were present. The purpose of the current study was to compare sagittal plane kinematics during device-assisted and clinician-assisted transfers in patients participating in an acute stroke rehabilitation program.

METHODS

Ten adults (50-82 years; 7 males) engaged in acute inpatient stroke rehabilitation participated. A single physical therapist (36 years of age, 8 years acute stroke rehabilitation experience) provided all physical and verbal patient assistance. A Vancare VeraLift (V) power-driven sit-to-stand unit was used for device-assisted trials. Twelve-camera motion analysis (Qualisys) documented sagittal plane kinematics of the trunk, pelvis and thigh (each expressed relative to vertical), as well as knee and ankle angles. Participants performed three device-assisted conditions: 1) giving best effort (V-BE); 2) providing no effort (V-NE); and 3) physical therapist guided motions using physical assistance and verbal cues (V-PT). A fourth trial, with only a physical therapist's assistance (PT), was performed. INITIAL (0% movement cycle; seated), PEAK (maximum flexion or extension achieved), and FINAL (100% movement cycle; standing) joint angles were quantified. Independent t-tests identified differences in INITIAL, PEAK and FINAL angles between each condition (PT, V-PT, V-BE, and V-NE) and a normative database [2] of unassisted sit-to-stand movements in individuals without pathology (CONT). Coefficient of multiple correlations (CMC) quantified similarities in movement profiles between each condition and CONT.

RESULTS AND DISCUSSION

CMC values comparing each activity's movement pattern to CONT data are provided in Table 1. Movement profiles for activities studied are displayed in Figure 1. Significant differences between CONT and each test condition's INITIAL, PEAK and FINAL kinematic positions are summarized for key body regions in Table 2.

Table 1: Coefficients of multiple correlation values comparing sagittal plane sit-to-stand kinematic profiles during each condition tested to control group angles.

Region	Condition			
	PT	**V-PT**	**V-BE**	**V-NE**
Trunk	0.93	0.48	0.38	0.43
Pelvis	0.90	0.66	0.49	0.74
Thigh	0.98	0.96	0.96	0.91
Knee	0.99	0.98	0.97	0.96
Ankle	0.45	0.38	0.30	0.44

The greatest similarity in movement patterns between all conditions and CONT data occurred at the thigh and knee as evidenced by the high CMCs (≥ 0.91). In contrast, relatively fixed ankle postures across test conditions poorly simulated CONT ankle motion (CMC ≤ 0.45). At the trunk and pelvis, the PT condition simulated CONT data most closely; however, the trunk was more flexed and the pelvis more anteriorly tilted at the beginning and end.

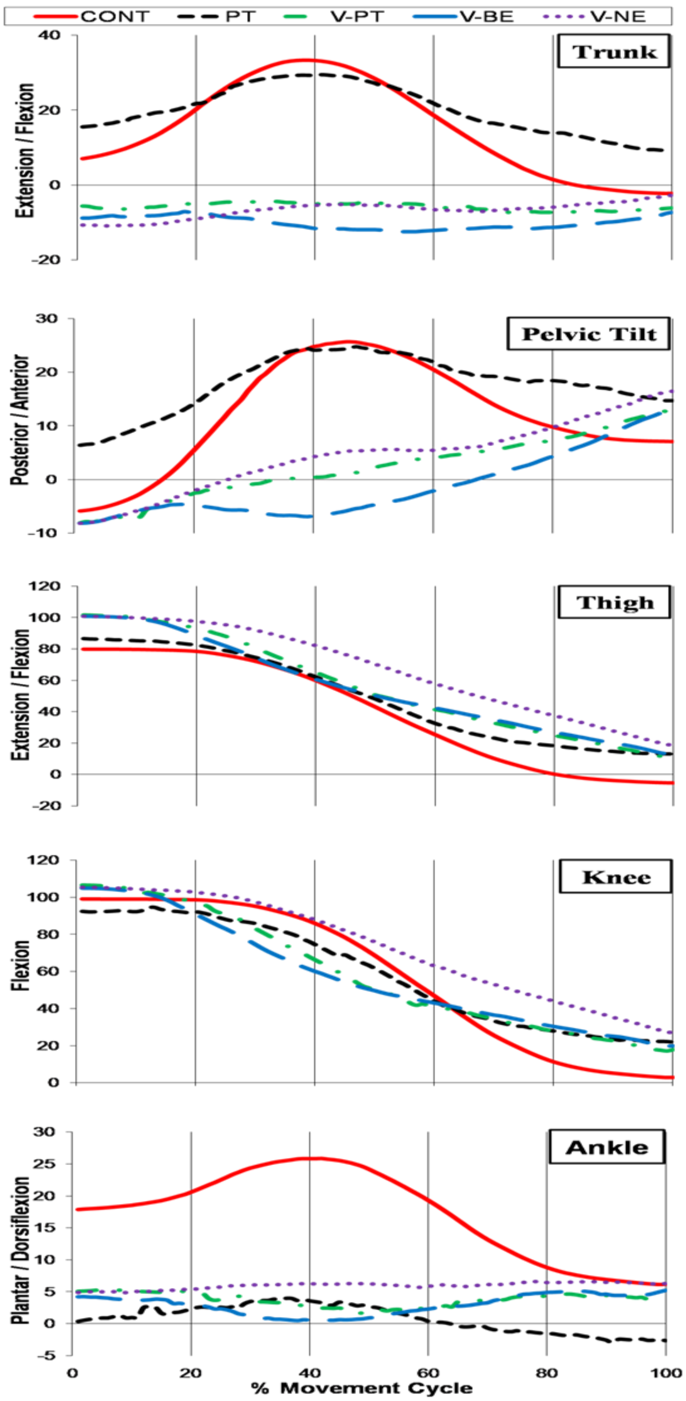

Figure 1: Sagittal-plane mean joint motion of the trunk, pelvis, thigh, knee and ankle during four conditions tested in patients recovering from a stroke. Normative sit-to-stand movement pattern displayed in RED.

Although the comparison of CMC values suggested that the PT condition most closely simulated CONT movement patterns at all joints compared to the device-assisted conditions, significant peak joint angle differences were identified in 10 of the 15 positions analyzed (Table 2). Within device-assisted conditions, the level of active participation of the clinician and patient primarily influenced movement profiles of the trunk, pelvis and ankle. CMC values suggest that the V-PT condition better approximated CONT trunk postures compared to V-BE and V- NE. The V-NE condition more closely simulated CONT pelvis and ankle postures compared to V-BE and V-PT.

CONCLUSIONS

Sit-to-stand movement patterns of individuals recovering from an acute stroke most closely simulated normal (CONT) when transfers were facilitated by the experienced clinician without use of the device. Further research is required to explore how movement patterns are influenced by use of alternate mechanical lift devices and clinicians of varying experience, fatigue levels, and anthropometrics. Additionally, the level of task-specificity (movement biofidelity) and repetition required to help patients relearn to move from a seated to standing posture independently has yet to be quantified. Given previous research indicating a 2.55 fold greater risk of back injury for clinicians performing >10 transfers/day [1], it is essential that techniques are identified to minimize clinician's risk while ensuring optimal patient outcomes.

REFERENCES

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2. McBride MM et al. *Online Proceeding ASB Annual Meeting:http://www.asbweb.org/ conferences/2009/pdf/931.pdf.*

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Table 2: Comparison of INITIAL, PEAK and FINAL joint positions during each condition to data recorded from individuals without pathology (CONT). Alpha level set at $p < 0.05$ (***** = No Significant Difference).

	Trunk	Pelvis	Thigh	Knee	Ankle
Start	PT>CONT>V-PT, V-BE, V-NE	PT>CONT	ALL>CONT	*	CONT>ALL
Peak	CONT>V-PT, V-BE, V-NE	CONT>V-PT, V-BE, V-NE	V-PT, V-BE, V-NE>CONT	*	CONT>ALL
Stop	PT>CONT	ALL>CONT	ALL>CONT	ALL>CONT	CONT>PT