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ORIGINAL ARTICLE

Impact of a Wheelchair Education Protocol Based on Practice Guidelines for Preservation of Upper-Limb Function: A Randomized Trial

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Abstract

Objectives: To determine if strict use of the Paralyzed Veterans of America's Clinical Practice Guidelines for Preservation of Upper Limb Function affects wheelchair setup, selection, propulsion biomechanics, pain, satisfaction with life, and participation of individuals with new spinal cord injuries (SCIs).

Design: Single blinded, randomized controlled trial.

Setting: Model SCI systems rehabilitation facility and community.

Participants: Volunteer sample of manual wheelchair users with new SCIs (N=37).

Intervention: The intervention group was strictly educated on the clinical practice guideline by a physical therapist and an occupational therapist in an inpatient rehabilitation facility. The standard of care group received standard therapy services.

Main Outcome Measures: Comparison of wheelchair setup, selection, propulsion biomechanics, pain, and Satisfaction With Life Scale and Craig Handicap Assessment and Reporting Technique scores at the time of discharge from inpatient rehabilitation and at 6 months and 1 year postdischarge.

Results: Participants in the intervention group pushed on tile with significantly lower push frequency ($P=.02$) at the discharge visit. On the ramp, the intervention group used a significantly larger push length ($P=.03$) across all time points. No significant differences were found between groups related to wheelchair setup, selection, pain, satisfaction with life, and participation.

Conclusions: The intervention group showed better skills on key wheelchair propulsion biomechanics variables related to upper-limb health. Use of a structured education program may be an effective method of educating new manual wheelchair users to prevent the development of upper-limb impairments in an inpatient setting. Additional follow-up testing is necessary to determine whether the differences seen in propulsion skills translate into decreased pain and improved quality of life in the long term.

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For individuals with lower-extremity paralysis caused by spinal cord injury (SCI), a wheeled mobility device is necessary to perform various tasks ranging from basic activities of daily living to necessary roles in society. For manual wheelchair (MWC) users, proper setup, selection, and propulsion technique are critical to maximize mobility and prevent upper-limb pain or injury.[1]

A lighter wheelchair reduces rolling resistance[2] and thus the amount of force needed to propel the device.[3] Adjustability allows the user to set up the device in a custom position to allow for optimal propulsion biomechanics. Research indicates that MWC

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users should attempt to decrease the number and force of propulsion strokes to reduce the risk of repetitive strain injuries at the shoulder and wrist.[4-8] Boninger et al[9] found that as pushrim contact increases, the health of the median nerve decreases. Several studies have shown that high forces correlate with injuries and/or pain at the wrist and shoulder.[4,6,10,11]

Despite extensive research on optimization of equipment and technique, upper-limb pain remains very common among wheelchair users. Between 49% and 73% of wheelchair users report the presence of carpal tunnel syndrome[12-17] and between 31% and 71% report shoulder pain.[12,15,16,18,19] Pain can develop very quickly after injury, with 35% to 78% of the individuals reporting that impairments began during the first 6 months to 1 year after injury.[20,21] The effects of pain can be substantial to a wheelchair user. Lundqvist et al[22] found pain to be the only characteristic associated with low quality of life, and Gerhart et al[23] found upper-limb pain to be one of the major reasons for functional decline. Although treatment methods exist and can be effective,[24] it is often impossible for a wheelchair user to completely rest his/her upper limb to allow healing to occur. Prevention of injury is therefore the most effective way to preserve upper-limb function.

Because of the significant effects of upper-limb pain/dysfunction and the need to prevent injury, the Consortium for Spinal Cord Medicine, in conjunction with the Paralyzed Veterans of America, developed a set of clinical practice guidelines (CPGs) for the preservation of upper-limb function.[1] The guidelines provide recommendations on the most advantageous wheelchair setup, selection, and propulsion characteristics to prevent the development of upper-limb impairments.

Since the publication of the CPG in 2005, limited research has been performed to clinically evaluate the recommendations. Rice et al[25] evaluated the effect of a training program based on CPG recommendations to improve MWC propulsion biomechanics. Results indicated that structured education based on the CPG recommendations can significantly improve key propulsion techniques associated with upper-limb health. Studies performed by Nash[26] and Norrbrink[27] and colleagues have investigated the effects of a structured exercise program on reducing shoulder pain. Both studies found a significant decrease in pain but had limited follow-up periods. In addition to the provision of a structured exercise program, Mulroy et al[28] educated participants to modify the performance of many common activities, such as wheelchair propulsion and transfer skills, based on CPG recommendations. Results indicated that after a 12-week in-home program, shoulder pain was significantly decreased and persisted for 4 months after the exercise program was completed.

To the best of our knowledge, no studies have examined the effects of implementing the CPG recommendations during the critical period of acute inpatient rehabilitation when novice wheelchair users are learning critical skills to allow them to actively participate in society.

The purpose of this study was to conduct a randomized controlled trial to determine the effects of strict implementation of the CPG recommendations on wheelchair setup, selection, and propulsion skills of persons with acute SCI compared with standard therapy instruction in an inpatient rehabilitation setting. A secondary analysis was performed to determine whether guideline implementation decreased pain and improved satisfaction with life and participation. We hypothesized that after being strictly educated on the CPG, the intervention group (IG) would have superior wheelchair setup, selection, and propulsion skills along with decreased pain and greater satisfaction with life and participation compared with the standard of care group (SCG) in the first year after injury.

List of abbreviations:

CPG	**clinical practice guideline**
DC	**discharge study visit**
IG	**intervention group**
MWC	**manual wheelchair**
NRS	**numeric rating scale**
SCG	**standard of care group**
SCI	**spinal cord injury**
WUSPI	**Wheelchair Users Shoulder Pain Index**

Methods

A single blind, randomized controlled trial was conducted at an acute inpatient rehabilitation facility in Pittsburgh, PA, between March 2007 and December 2011. Per approval by the University of Pittsburgh Institutional Review Board, new admissions to the rehabilitation facility were screened to determine whether they (1) were between 16 and 110 years old, (2) were first-time wheelchair users, (3) had a nonprogressive SCI with residual neurologic deficits, (4) were anticipated to be a full-time wheelchair user, and (5) scored >17 out of 25 on a modified Mini-Mental State Examination.[29] If a participant met all inclusion criteria and was agreeable, an informed consent approved by the University of Pittsburgh Institutional Review Board was signed. After enrollment, participants were randomized (1:1) to either the SCG or the IG. Because both injury level and sex have been found to have an effect on pain, a stratified randomization scheme was used to ensure that an equal number of males and females and individuals with tetraplegia and paraplegia were assigned to each group. A total of 93 (IG=45, SCG=48) participants were enrolled; however, only independent MWC users (n=37) were included in this analysis. Participants in the SCG received standard, inpatient acute rehabilitation physical and occupational therapy treatment on a designated SCI unit from clinicians familiar with providing care to individuals with acute SCI. The SCG clinicians were asked not to change treatment strategies because of the potential involvement of their patients in the research study. As much as possible, the study status of participants was concealed from the SCG clinicians. Participants in the IG received instruction from a physical therapist and an occupational therapist who followed a strict education protocol on upper-limb preservation that was based on CPG recommendations. All other aspects of SCI education not related to upper-limb preservation were not affected by study interventions.

The strict education protocol and original materials (see supplemental appendices S1 and S2, available online only at http://www.archives-pmr.org/) were developed by physiatrists, physical therapists, and occupational therapists familiar with the CPG[1] and working in the field of SCI rehabilitation. Past research[30-32] has found that the method of guideline implementation is critical in the retention of information. A 2005 study by Burns et al[31] investigated large-scale, passive implementation (simple distribution of the materials without an implementation protocol) of a CPG to prevent the development of deep vein thrombosis. Results found that in general, the guidelines were not