

## INCREASED FORWARD LEAN AMONG WHEELCHAIR USERS WITH USE OF A DYNAMIC PELVIC STABILIZATION DEVICE

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### ABSTRACT

The HipGrip is an innovative spring-loaded pelvic stabilization system for persons who have difficulty maintaining their position in the wheelchair. The HipGrip mechanically links the user to the wheelchair to provide a stable and dynamic base of support. The objective of this research study was to determine the effects of using the HipGrip on the user's ability to lean forward. Ten subjects (6 spinal cord injury, 4 cerebral palsy) performed a functional forward lean test. Using a single-subject study design, results obtained with use of the HipGrip were compared to their personal seating system. With use of the HipGrip, seven out of 10 subjects were capable of leaning further forward by an average of 6.4 cm (ranging from 3 to 12 cm). Preliminary results indicate that the HipGrip may increase wheelchair users' ability to lean forward by increasing pelvic stability and assisting the user in returning to an upright position.

### BACKGROUND

The neutral posture of the pelvis is dynamic; therefore, pelvic support should allow for movement to occur while assisting in maintaining proper pelvic posture and stability. A stable base of support can enhance upper body function (1). Currently available pelvic positioning devices, including lap belts and sub-ASIS bars, may stabilize and support the pelvis but do not allow dynamic pelvic movement. Lap belts do not always control undesired pelvic movement. Rigid devices like sub-ASIS bars fix the pelvis into a static position and do not allow for natural pelvic movement. Subtle movements of the pelvis are critical to maintain an active posture (2); therefore, it should not be rigidly stabilized.



Figure 1. The HipGrip, a dynamic pelvic stabilization device

The HipGrip is a dynamic pelvic stabilization device that maintains a neutral pelvic position while allowing desired pelvic movement to occur (Figure 1) (3). The HipGrip consists of a padded rear shell and a padded front belt that “grips” the pelvis. A spring-rod pivot mechanism links the HipGrip to the wheelchair and gently guides the pelvis back to a neutral position after movement occurs.

### RESEARCH QUESTION

The objective of this study was to evaluate an innovative pelvic stabilization device that allows for functional and dynamic pelvic movement to occur while maintaining neutral pelvic positioning. The specific hypothesis of this study was that the HipGrip would increase the user's ability to lean forward.

# DYNAMIC PELVIC STABILIZATION DEVICE

## **METHODS**

A functional forward lean test was used to compare the capabilities of subjects using their personal seating system with using the HipGrip. A HipGrip was installed in each subject's personal wheelchair. Subject testing took place in the wheelchair with its original configuration and then was repeated with the HipGrip installed in the subject's wheelchair.

### Study Population

Ten subjects (6 male, 4 female) participated in this study: six with spinal cord injury (SCI) and four with cerebral palsy (CP). The subjects ranged from 24 to 60 years of age, 56 to 75 cm in height, and 34 to 88 kg body weight. All subjects used a wheelchair for their primary means of mobility and experienced some difficulty maintaining pelvic positioning.

The personal seating system for all subjects with spinal cord injury consisted of a sports wheelchair and seat cushion. In addition, one subject with spinal cord injury (SCI-204) used a lap belt and another (SCI-207) used an abdominal belt. The personal seating system for one subject with cerebral palsy (CP-209) consisted of a wheelchair with a back support, anti-thrust cushion, and lap belt. The personal seating system for the two other subjects with cerebral palsy (CP-205, CP-208) consisted of a wheelchair with a custom seat cushion and back support, lateral trunk supports, lateral hip supports, head support, and a sub-ASIS bar.

### Forward Lean Test

The functional lean test measured how far forward subjects could lean while reaching forward and maintaining the ability to return to their upright sitting position. The functional lean test is a modification of the Modified Functional Reach Test (4). The Modified Functional Reach Test was adapted to allow subjects who do not have the upper body control to sit independently and/or the upper extremity control to maintain 90 degrees of shoulder flexion to participate in this study. For each trial, a baseline measurement of the acromion position was taken with the subject sitting in an upright resting position and then a measurement was taken at the subject's furthest forward lean position. If the subject was capable, the non-reaching arm was held over the navel, otherwise it was held in a free, non-weight bearing position. Three forward lean trials were measured from both the left and right acromion process for all subjects.

### Data Analysis

The lean measurement was calculated as the distance between the acromion process at the furthest forward lean position and the acromion process in the upright resting position. The maximum lean obtained from the 6 trials (3 left, 3 right) was calculated for both the personal seating system and the HipGrip. The difference in maximum lean obtained in the HipGrip and maximum lean obtained in the personal seating system was calculated for each subject.

## **RESULTS**

Seven out of 10 subjects achieved greater maximum forward lean using the HipGrip by an average of 6.4 cm, ranging from 3 to 12 cm (Figure 2). One subject experienced no change in forward lean using the HipGrip and two subjects had decreased forward lean (-0.5 cm, -1 cm) using the HipGrip. Two of the three subjects (CP-209, SCI-210) who did not experience an increase in forward lean already had good leaning capabilities (61.5, 60.5 cm) and the other subject (CP-208) had no detectable movement (ranging from 0 to 0.5 cm).

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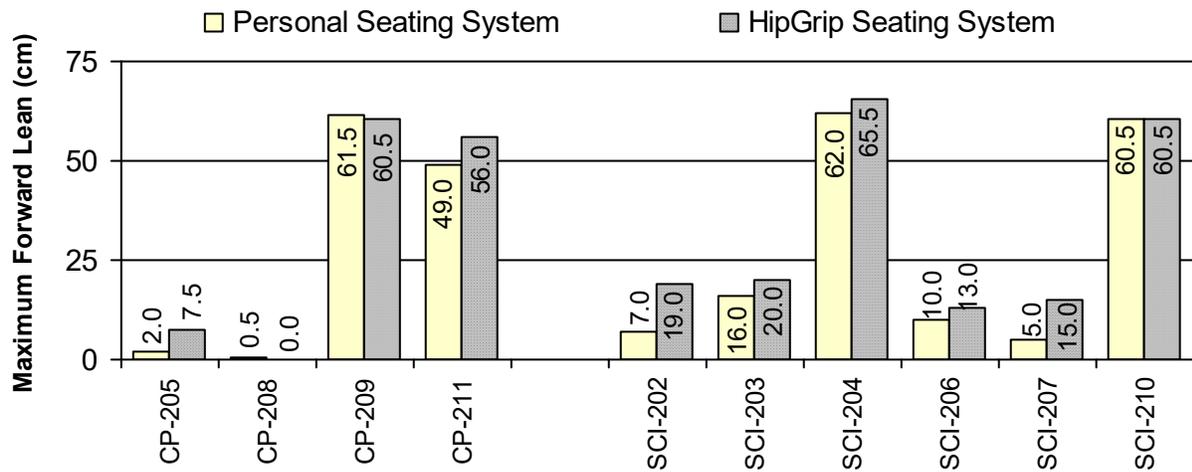


Figure 2. Results of Forward Lean Test

## DISCUSSION

The HipGrip allowed seven out of 10 wheelchair users who have difficulty maintaining neutral pelvic posture to achieve a greater forward lean than they could when using their personal seating systems. This was attributed to the increase in pelvic stability provided by the HipGrip. For those subjects who did not achieve a greater forward lean, the HipGrip may still provide better pelvic positioning and overall comfort for the subject. Study limitations include a small sample population and learning effects that may have occurred with the forward lean task. These preliminary data suggest that the HipGrip will enhance upper body function in many people who have difficulty maintaining pelvic stability in their wheelchair. Further testing is currently in progress to evaluate and quantify the ability of the HipGrip to maintain a neutral pelvic posture and enhance upper body function.

## REFERENCES

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# DYNAMIC PELVIC STABILIZATION DEVICE

## TEXT DESCRIPTION OF FIGURES

Figure 1. This figure is of the HipGrip installed in a wheelchair. The HipGrip consists of a padded rear shell, a padded front belt, a pivot mechanism, and wheelchair attachment hardware.

Figure 2. This figure is a bar graph representing maximum forward lean for subjects with cerebral palsy and spinal cord injury. The first set of bars represents maximum forward lean using the personal seating system and the second set of bars represents maximum forward lean using the HipGrip. Refer to Table 1 for the data in tabular format.

Table 1. Forward Lean (cm)		
Subject	Personal Seating System	HipGrip Seating System
CP-205	2.0	7.5
CP-208	0.5	0.0
CP-209	61.5	60.5
CP-211	49.0	56.0
SCI-202	7.0	19.0
SCI-203	16.0	20.0
SCI-204	62.0	65.5
SCI-206	10.0	13.0
SCI-207	5.0	15.0
SCI-210	60.5	60.5