Restoring Mobility to a Paraplegic Using the NewGait, a Wearable Harness System: a Case Report

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Background and Purpose

In the United States there are over 340,000 people living with a spinal cord injury who have needed extensive rehab to maximize their function. Once medically stable, most of these patients transferred to large urban rehab settings specializing in spinal cord recovery for rehab. Typically these settings have body weight supported treadmills and robot assisted gait trainers available for functional gait training /exercise. These devices have been shown to be more effective than conventional therapy in improving walking tolerance, speed and performance of functional tasks in this particular patient population. ***(Wirz, Markus. Effectiveness of automated locomotor training in patients with chronic incomplete spinal cord injury; a multicenter trial. Archive of Physical Medicine and Rehabilitation Volume 86 Issue 4, April 2005 Pages 672-680)***

Unfortunately once patients are discharged they do not have access to these devices at their less specialized/ smaller PT clinics or local gyms and they lose the gains they attained while in the larger rehab setting. When surveyed, the majority of spinal cord injured patients said that exercise was important to functional recovery. However, more than half stated three years post injury that they were not exercising or working on their mobility anymore because they either did not have access to exercise or to a trained therapist to oversee that exercise. ***(Anderson , Kim Targeting recovery: priorities of the spinal cord –injured populations. Journal of Neurotrauma 21 (10) 1371-1383, 2004*** A device is needed that can mimic the facilitation given by the robot or body weight-supported treadmill but is cost effective and simple enough to be available in smaller clinics or even at home once patient transitions back to their home setting. This is imperative not only for their physical health but for their mental and emotional health as well. They need hope that they will continue to become more functional.

The purpose of this case report is to introduce a simple wearable harness system, originally design for sport performance, and to describe how it was used in spinal cord rehab to help an incomplete paraplegic become a functional ambulator.

Case Description: Patient History and Systems Review

A 24 year old female fell 12-14 feet and landed on her buttock on a cement floor causing a T12 burst fracture with paraplegia. The patient underwent a T12 vertebrectomy, T11-12 fusion and percutaneous posterior fusion to stabilize the spine. Once she was medically stable, she was given the choice of where to go for rehab: either a large rehab hospital specializing in spinal cord eight hours from her home or an inpatient rehab center at a local hospital close to her family and her support system. The patient decided to stay close to home. When she was discharged home five weeks later she required minimal assist for transfers. She was ambulating on an occasional basis with bilateral AFO's, TLSO and wheeled platform walker but predominantly she was using a wheelchair for household and community mobility.

Examination

Upon evaluation in outpatient physical therapy one week later, she presented as a T12 incomplete paraplegic with the following strength limitations:

- Right ankle dorsiflexion of 2/5 and left of 1+/5 with some spasticity.
- Hip flexion, extension and abduction and knee extension strength of 3+/5 bilaterally.
- Core strength was limited to 3/5 but with almost no ability to contract her pelvic floor.
- There was spasticity noted in bilaterally plantar flexors and hamstrings.

She was using the wheelchair as her primary source of mobility although she was using the walker for short distances in the family home. She was a farm girl and it was her goal to not only walk again but be able to run and chase her cows back into the fence.

Clinical Impression

The patient was very motivated and compliant during clinic visits and at home. She continually looked for more that she could do to aid her recovery. Her drive motivated her therapist to start thinking outside of the box to maximize her functional outcome. One particular problem the therapist was trying to find a solution for was the patient's struggle with her AFO's. She was a farm kid who lived in muck boots. The AFO's would not fit in her boots and were very uncomfortable. She rarely wore them outside of the clinic. When she did not wear them her gait pattern was very sloppy and unstable.

After six visits, she was walking short distances with just two canes and braces (TLSO and AFO's). After ten weeks, she could walk short distances without any assistive device or braces on level surface but her gait pattern was not symmetrical or sustainable. It was a" steppage pattern" with bilateral recurvatum at the knee, poor trunk control, excessive thoracic kyphosis and no arm swing. Her walking speed for 15 meters was .7 m/sec.

Novel approach: Initiated ten weeks into outpatient PT/ 5 months post injury.

Trialing the NewGait harness in this case was simply an application inspiration. The harness was not even on the market yet for its original purpose of sports performance enhancement. The therapist had seen the device and thought its components might impact the patient's gait issues:

- Rigid waist band and shoulder harness to give core stability.
- Elastic bands of varying durometers to assist the quads (address recurvatum). (Eventually the apparatus was modified to also assist with ankle dorsiflexion and the hip abduction).
- Elastic bands of varying durometers that cross the hip, (and eventually the knee and ankle joints) that would give compression which might improve stability by assisting stabilizers and improve joint proprioception.

She contacted the manufacturer and asked if she could trial the unit in the rehab setting. They agreed to the trial and sent her a harness. The patient started to use the device 3x/week in the clinic during gait training and closed chain exercise. A walking test was administered with videography with and without the use of the NewGait harness. This test was repeated one time per month. Speed, stride length and quality of gait pattern were measured and recorded.

Outcome

The immediate acute effects of the NewGait harness were:

- Patient stood more upright and displayed better trunk control.
- Patient started to swing her arms and rotate trunk during gait.
- Knee recurvatum improved.
- Compensatory motions of leg circumduction and increased hip flexion to clear foot during swing phase decreased.
- Walking speed increased from 0.8 m/sec to 1.1 m/sec.

Within three treatment sessions patient was able to start walking on the treadmill both forward and backward without upper extremity support while wearing the NewGait. Occasionally she took the harness home with her and used it to walk outdoors pushing her nephew in the stroller. Within one month, she was walking three miles pushing the stroller.

It was observed by the therapist that even when she was not wearing the NewGait, her gait quality was improving. She was standing taller, had better control at the pelvis and less accentuated hip flexion and circumduction to clear her feet. These improvements translated into improved stride length and walking speeds with and without the harness. See table below for details

Walking Speeds and Stride Length over Time

Month	Stride length w/o NewGait	Stride length with NewGait	Walking speed w/o NewGait	Walking speed with NewGait
initial	18 inches	27 inches	.8 m/sec	1.1m/sec
End Month one	25 inches	32 inches	1.4 m/sec	1.4m/sec
End Month two	30 inches	35 inches	1.4m/sec	1.9m/sec

One month after the NewGait was initiated, the patient started running wearing the harness. This was a huge milestone and personal victory because running was the one thing that she was told she would never do again. Three weeks later, she clocked a 12 minute mile. She tried running without the NewGait but could not run more than a minute before she was exhausted.

The patient obtained a NewGait harness for home use and wore it running one to three miles two or three days per week. The patient was discharged from physical therapy as a functional community ambulator without the use of a cane, AFO or TLSO or NewGait harness. Her gait pattern was steady and symmetrical, and her speed and stride length were very functional.

Discussion:

Spinal cord injury and the loss of function and independence is one of the most devastating traumas that one can suffer. Recovery occurs at many levels and over a long period of time. These patients require the expertise of highly trained rehab specialists who are aware of the technology available to aide in their recovery. The love and support of their families and the normalcy of home is also important to promote recovery. The importance of each of these needs is unique to each patient. The goal of healthcare should be to support a patient's choice regarding rehab location and work to maximize their recovery no matter what the setting. Since a spinal cord injury will involve life-long repercussions, healthcare should also focus on long-term activities that keep these patients mobile and give them hope for improved mobility.

This case study suggests that the NewGait, a wearable harness, could be of assistance to the incomplete SCI patient throughout the span of recovery. If the patient is seen in a large rehab unit specializing in spinal cord rehab, the device could be a transitional device to promote neuromuscular reeducation after body weight supported treadmill training or robot-assisted gait training have been completed. The device is simple to don and cost effective enough that it could be purchased for long term home or clinic/gym use. The device could also be the primary neuromuscular-facilitating apparatus for ambulation if the patient stays in a smaller rehab center with fewer resources. The promising results in this case study warrant a multi-site controlled study of its effectiveness as well as a study of the barriers to its use.