



International Center for Spinal Cord Injury  
at Kennedy Krieger Institute  
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# NEUROLOGICAL AND FUNCTIONAL RECOVERY FOLLOWING LONG-TERM ACTIVITY-BASED RESTORATIVE THERAPY IN A PATIENT WITH CHRONIC INCOMPLETE CERVICAL SPINAL CORD INJURY

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## INTRODUCTION

There are currently an estimated 253,000 people living with spinal cord injury (SCI) in the United States, with approximately 11,000 new cases each year.

Patients are typically told that that improvement or recovery largely occurs within the first 6 months.

•Recovery is dependent on the initial level or injury, initial strength of the muscles, and whether the injury is complete or incomplete.

•The American Spinal Injury Association (ASIA) Impairment Scale is the most valid and reliable classification to assess spinal cord injury.

•Only a small percentage of subjects have motor recovery below the first caudal level from the neurological level of injury, and just 2.8% of patients originally classified as AIS A will convert to AIS D.

Rehabilitation following SCI has previously focused on compensatory strategies for loss of function below the level of injury, as significant functional recovery was not expected. More recently, new techniques for rehabilitation after SCI have emerged, including activity-based therapies.

•Activity-based restorative (ABR) therapy is based on activity-dependent plasticity of the central nervous system, which refers to repetitive activity that drives changes in the neuromuscular system below the level of the lesion.

•The goal of ABR therapy is to retain the nervous system to recover sensory and motor function by activating the neuromuscular system below the level of injury.

•It has been demonstrated in the literature that activity-based therapies promote recovery and functional improvements in patients with SCI.

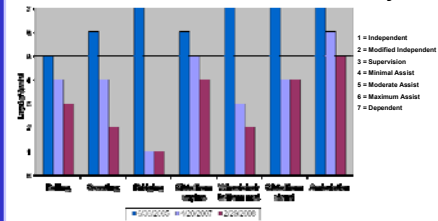


Interventions consisted of FES cycling, FES-assisted strengthening, reciprocal UE/LE movement in standing frame with and without glider component, partial body weight supported gait training over treadmill and overground, overground gait training with and without use of FES, stretching, balance activities, and functional mobility training. An average week for this patient consisted of participation in 15 to 20 hours of ABR therapies, accounting for combined time at clinic and home.

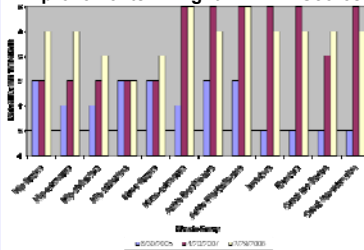
### Outcome Measures

The following outcome measures were utilized: AIS classification, ASIA scores, manual muscle test (MMT) scores, Walking Index for Spinal Cord Injury (WISCI II), balance grades, and levels of assist for functional mobility. AIS classification and ASIA scores were assessed every 1-3 months by the attending physician and other outcome measures were assessed every 30 days by the primary physical therapist.

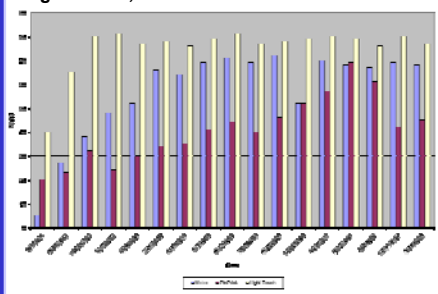
## Levels of Assist for Functional Mobility



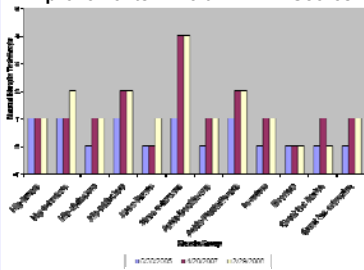
## Improvements in Right LE MMT Scores



## Light Touch, PinPrick and Motor ASIA Scores



## Improvements in Left LE MMT Scores



## Balance Scores

	6/30/05	4/20/07	2/29/08
Static sitting balance	Fair	Fair+ Good-	Fair+ Good-
Dynamic sitting balance	Poor+	Fair	Fair+
Static standing balance	Poor	Poor+	Fair-
Dynamic standing balance	Poor	Poor	Fair-

## DISCUSSION

Patients with cervical spinal cord injury, particularly those initially classified as having a complete SCI, are not predicted to have significant recovery after 6 months post-injury. This subject demonstrated clinically meaningful recovery greater than 6 months following initial injury, which continued for longer than 3 years post-injury. Both neurological and functional recovery occurred in the chronic phase of injury, with participation in an intensive ABR therapy program that took place on a clinical and home basis. Patient demonstrated excellent compliance to this program, which also likely contributed to her extent of recovery.

### Ideas for future research

Ideas included obtaining results of multiple cases of patients involved in ABR therapy who experience clinically meaningful recovery following SCI while greater than 6 months post-injury. Randomized control trials would ideally study an ABR therapy group versus traditional therapy group of patients who are stratified according to similar classification of injury and functional capabilities.

## CONCLUSION

This case report illustrates the following:

- Clinic-based and home-based ABR therapies are both effective modes of rehabilitation to promote neurological and functional recovery
- Intensity of therapy and patient compliance play an important role in recovery from SCI
- Late recovery in the chronic stage of spinal cord injury occurs with participation in ABR therapy
- Delayed recovery of motor, light touch, and pinprick ASIA scores occurs with participation in ABR therapy
- Delayed conversion of AIS classification occurs with participation in ABR therapy
- Manual muscle test scores, balance, and level of assistance required for functional mobility improve with participation in ABR therapy

## PURPOSE

The purpose of this case report is to describe the neurological and functional recovery which occurred in a patient with chronic cervical incomplete spinal cord injury following a long-term bout of activity-based restorative therapy.

## RESULTS

The patient demonstrated neurological and functional recovery throughout participation in ABR therapy. She was originally classified as having a C4 AIS A spinal cord injury, which converted to C5 AIS D approximately 2 years after her initial injury.

## Improvements in WISCI II Score

Date	WISCI II Score	Description
6/30/05	0/20	Client is unable to stand and/or participate in assisted walking.
4/20/07	6/20	Ambulates with walker, with braces, and physical assistance of one person, 10 meters.
2/29/08	6/20	Ambulates with walker, with braces, and physical assistance of one person, 10 meters.

## ACKNOWLEDGEMENTS

Special thanks to Karen Good, PT, Beth Myers, PT, Cristina Sadowsky, MD, and John McDonald, PhD, MD for their guidance and assistance in creating this poster.

## METHODS

### Case Description

Patient was a 49-year-old Caucasian woman with no significant past medical history prior to an equestrian accident resulting in traumatic SCI on September 1, 2004.

Patient sustained complex C4-C6 fracture and subluxation, she received

Solu-Medrol in the first 1-2 hours, and underwent C5 corpectomy and C3-6 cervical fusion in the first 16 hours. Initial classification of injury was C4 AIS A.

Rehabilitation prior to initiating ABR therapies included: inpatient rehabilitation x 2 months, nursing home x 3 months, and traditional outpatient therapy x 6 months. The patient presented for evaluation at the International Center for Spinal Cord Injury (ICSCI) at the Kennedy Krieger Institute on 06/30/05 stating, "I don't feel like I belong in a wheelchair."

### Interventions

An intensive model of ABR therapy was utilized with this patient, which included both clinic-based and home-based interventions. Patient participated in PT and OT services and was compliant and diligent in performing all home-based recommendations. Patient attended clinic-based therapy from 09/08/05 through 04/20/07 and from 6/1/07 through 2/29/08. Frequency varied from one to three clinic sessions per week, with each session lasting 2 to 3 hours.