

## LETTER TO THE EDITOR

### COMMENT ON “RESTORATION OF WALKING FUNCTION IN AN INDIVIDUAL WITH CHRONIC COMPLETE (AIS A) SPINAL CORD INJURY”

*Sir,*

The case report by Manella et al. (1) describes an interesting case of late partial recovery of walking function in an individual with clinically complete spinal cord injury (SCI).

The individual was classified as American Spinal Injury Association Impairment Scale A (AIS A) according to the International Standards of Neurological Classification in Spinal Cord Injury (ISNCSCI) (2).

This case report adds valuable evidence to the current body of literature by emphasizing the potential for activity-induced functional recovery to occur even 2 years after SCI. It is important to recognize that the central message of this paper is the functional improvement. However, the authors also describe a conversion on the AIS from A to C. With the data provided, this conclusion cannot be entirely supported. This inconsistency should not detract from the overall finding of late partial recovery and in no way diminishes the value of the case study. Rather, it illustrates some of the difficulties of the AIS.

In order to confirm conversion from AIS A to AIS C, it is mandatory that previously absent sacral sparing re-emerges. The data presented in this report describes the participant as exhibiting no sensory function below the level of T8 4 months prior to enrolment into the study. Beginning approximately 5 weeks after initiation of locomotor training and thereafter, sensory assessments revealed no sensory function below T12. In the absence of specific information regarding the quality of sensation (i.e. normal vs impaired) above those levels, this data is insufficient to determine the sensory level. On the other hand, it does allow us to conclude that there was definitely no sensory sacral sparing at any of the assessment time points. In the absence of sensory sacral sparing, re-occurrence of any sacral sparing can only occur if voluntary anal contraction (VAC) is present. However, this critical piece of information is not provided in the report. Therefore, the conclusion that the participant converted from AIS A to AIS C is not supported by the data provided.

If available, we encourage the authors to present the information on VAC at all assessment time points. Additionally, to complete the picture we also suggest inclusion of the sensory level of injury at all assessment time points. Assuming that this

level will fall in the thoracic region, the sensory level will then automatically provide the motor level according to the “motor follows sensory rule” (2). It should be emphasized that, although the different levels of injury reflect important information worthy of presentation, in this specific case the sensory level will not influence the AIS. In the absence of sensory sacral sparing, the patient will be classified either as AIS A (if VAC is absent) or AIS C or D (if VAC is present). Only if there was sensory sacral sparing would the sensory and motor levels of injury be important for AIS classification. In this case, the presence of muscle function more than 3 levels below the motor level of injury would classify the individual as AIS C or D even in the absence of VAC. Therefore, the sensory and motor levels of injury would become a crucial piece of the decision process.

Correct AIS evaluation requires both assessment and classification skills. We have previously recommended using computer algorithms to improve accuracy of classification (3). In an effort to help standardize the classification part of the AIS, improve reliability, and hence increase its clinical and research value, our group has made such a computer algorithm available online (<http://ais.emsci.org/>) (4). Please feel free to use this for your work. Any feedback about the algorithm is welcome and can be directed to Christian Schuld (Christian.Schuld@med.uni-heidelberg.de).

#### ACKNOWLEDGEMENTS

We wish to thank doctoral advisors Dr Andrea Behrman and Dr Carolynn Patten from the University of Florida for their encouragement and support in preparing this letter.

Submitted November 23, 2010; accepted December 21, 2010

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#### RESPONSE TO LETTER TO THE EDITOR BY SPIESS ET AL.

We thank the authors of the Letter for their thoughtful insights regarding our case report. We are pleased that they are in accord with the importance of the primary point of the report; that with intensive training functionally meaningful motor recovery may

occur in individuals with clinically complete, chronic spinal cord injury (SCI). In addition to improved sitting balance and reduced spasticity, the participant recovered function in the hip flexors and hip extensors, resulting in the restoration of some walking

function. Prior reports of locomotor training in individuals classified as American Spinal Injury Association Impairment Scale (AIS) A and B have not resulted in recovery of overground walking function (5, 6), perhaps suggesting that the combination of intensive physical therapy and robotic locomotor training was more effective than locomotor training alone.

As a secondary point, we asserted that the recovery of some motor function more than 3 segments caudal to the T7 neurological level warranted reclassification from AIS A to AIS C. Prompted by the Letter, we have revisited the International Standards of Neurological Classification in Spinal Cord (IS-NCS) criteria (2). We concur that in addition to recovery of motor function more than 3 levels caudal to the neurological level, the AIS C classification requires that there be anal sensation. The participant's neurological level remained T7 at all assessment time points, and despite recovery of some sensory function to T12 and motor function to L2 (or to S1 if one considers the hip extensors, which are not a component of the AIS classification), the participant recovered neither sensory nor motor function in the S4-5 distribution. We therefore concede that the AIS A classification was retained following training. As we note in the Discussion, it is possible that the injury was "discomplete" (7), if so then spared pathways may have been responsive to the intensive task-specific training, resulting in improvement beyond that typically observed for an individual with a chronic AIS A T7 injury. We congratulate the authors on the development of their web-based classification algorithm. Undoubtedly, the availability of this algorithm will be of great value for reliable classification of spinal cord injury.

While we agree with the authors of the Letter that in the absence of anal sensation the sensory recovery observed in this participants irrelevant to the issue of conversion, we feel

obliged to point out that sensory recovery is relevant for other reasons. In addition to the protective advantages of being able to sense noxious stimuli that could potentially damage tissue, there are other positive implications for improved sensation that impact quality of life, such as being able to feel the touch of a loved one. This is not the first report of rehabilitation-induced recovery of sensory function in individuals with disorders of the central nervous system. We have previously reported improvements of sensory function in individuals with spinal cord injury following a rehabilitation intervention combining task-specific training with electrical stimulation (8), and there is a report of improved sensory function in individuals with multiple sclerosis associated with an electrical stimulation intervention (9).

Based on discussions with individuals with SCI and with rehabilitation colleagues, we believe that the type of recovery we observed in our participant occurs regularly in those with SCI who have the financial means to avail themselves of intensive rehabilitation in the chronic stage of injury. It is common knowledge that in most areas of the world individuals with SCI are discharged from rehabilitation long before reaching their maximum potential for neural recovery. Unfortunately, it is likely that latent potential for recovery is often not realized in the absence of the opportunities to participate in intensive training in the chronic stage of SCI.

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