Monitoring of the rehabilitation progress of subjects with incomplete Spinal Cord Injury

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# Introduction

Monitoring the recovery process during rehabilitation of individuals with incomplete spinal cord injury (iSCI) is an important issue to evaluate therapeutic approaches and to motivate the patients to continue their rehabilitation efforts. The testing of functional outcome as provided by the ASIA motor score can be improved by interval scaled measurements (van Hedel et al. 2006). In the present study we describe a fast and objective measurement tool to assess changes in the functional ability of individuals with iSCI.

# Materials and Methods

For this study an instrumented cycling system (Reichenfelser et al., 2008) was used that can drive the cranks at constant speed and is equipped with force measurement cranks and orthoses to stabilize the patients’ legs on the pedals. On this cycling system 23 patients (7 tetraplegic, 16 paraplegic, 3 female, 20 male, mean age 40(SD14) years, lesion height: L1 to C4, ASIA Score: B-D) performed 17(SD 14) therapy sessions as part of their clinical rehabilitation program. During each therapy session a power output test was performed, where the patient’s active power output was assessed for each leg at two crank speeds, 30 and 60 rpm. The patient was asked to propel as hard as possible over 10 isokinetic crank revolutions and the generated power output was calculated via the applied pedal forces and the induced motor current.

# Results and Discussion

Representative results of one patient are shown in figure 1.The bars express the patient’s total power output and the contribution of each leg at 30 rpm. For this subject the power output steadily increased over the therapy period and the diagram points out that the improvement of muscle force and coordination is bigger in the right leg than in the left one.



Fig. 1: Development of the power output of a patient with incomplete paraplegia (male, age 47, motoric lesion height TH11, ASIA D) over a time period of 66 days

The results of 20 further patients differ only by the dynamic of the progress and by the absolute values of the power outputs which were performed.

As expected the power output for most patients was higher at 60rpm, but two tetraplegic subjects showed higher values at 30 than at 60 rpm. Our suggestion is that at lower speeds the results mainly reflect the active muscle force while at higher rotational speed of the crank coordinative abilities have a higher effect on the power output.

This may also be the explanation for the results of one specific subject, whose power output decreased in the tests at 30rpm over the period of two month. This indicates a loss of active muscle force maybe due to the loss of muscle mass. On the other hand the patient’s coordination got better, which is pointed out by the increasing values of the tests at the speed of 60 rpm.

# Conclusion

The results show that the recovery process can be monitored reliably by the specially equipped tricycle together with the predefined test routines. The power output test at the two cadences 30 and 60 rpm can be used to examine both, the development of muscular force and the patient’s coordinative progress. Further investigation could focus on the correlation between cycling and walking abilities e.g. by comparing the described power output test with the 10-Meter Walk Test.

Literature

Reichenfelser et al. Trainings- and Measurement-System for FES-Cycling. Biomedizinische Technik (2008), 53 Suppl.1: 265-267.

van Hedel et al. Improving walking assessment in subjects with incomplete spinal cord injury: responsiveness. Spinal Cord (2006), 44:352-356.