

Increasing fitness with FES rowing

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Introduction

Functional electrical stimulation assisted rowing (FES-rowing) can be used as a rehabilitation procedure and recreational activity for persons with lower-limbs paralysis¹. In FES-rowing typically quadriceps and hamstring muscles are stimulated, which improves the status of the cardiovascular system and increases muscle mass^{2,3}; thereby, the risk from secondary complications associated with the sedentary lifestyle imposed on those who are unable to ambulate is reduced. The aims of the present study were (i) to assess the effectiveness of FES-rowing in young healthy subjects as compared with rowing alone; (ii) to evaluate the feasibility of rowing combined with the coordinated stimulation of 3 muscle groups (quadriceps, hamstrings and triceps surae).

Material and Methods

16 young healthy subjects were divided into two groups: FES-ROWING and ROWING. FES-ROWING group was exercising 45 minutes, twice a week for six weeks, on a rowing machine (Concept 2, USA) equipped with MOTIMOVE stimulators (3F-Fit Fabricando Faber4, Belgrade, Serbia) and the ROWING group was exercising with same conditions, only without FES. One session per week comprised 3 intervals of 8 minutes alternating 30 seconds of rowing at 100% of each subject's maximal aerobic power (MAP) and 30 seconds of resting to allow the recovery. The second session in the week comprised 3 periods of 10 minutes at 65-40% of MAP. Three muscle groups (quadriceps, hamstrings and triceps surae) were stimulated in a defined timing to superimpose the electrical stimulation on the voluntary activity of the muscles. The intensity of stimulation was set to maximally tolerated intensity, pulse width 450µs, frequency 40 Hz (biphasic, exponentially compensated, current controlled pulses). Before and after 6-week training we measured maximal aerobic capacity as well as muscle width and maximal force of quadriceps, hamstrings and triceps surae muscles. Average watts and heart rate were monitored during each session. .

Results

There was a significant difference in outcomes between the FES-ROWING and the ROWING group. FES-ROWING outperformed in each of the three categories (strength, muscle mass, and maximal aerobic capacity). All subjects tolerated FES well.

Discussion

The results suggest that FES assisted rowing can be used to increase muscle mass, strength and endurance compared to regular exercise in young healthy subjects. The early results in persons with paralysis fit with the results in healthy confirming our hypothesis that the FES-rowing should be used in rehabilitation.

References

- [1] Deley G et al.: Functional electrical stimulation: cardiorespiratory adaptations and applications for training in paraplegia, *Sports Med.* vol. 45:, pp. 71-82, 2015
- [2] Taylor JA et al. : Aerobic capacity with hybrid FES rowing in spinal cord injury: comparison with arms-only exercise and preliminary findings with regular training, *PM R* vol. 3, pp. 817-824, 2011
- [3] Deley G et al.: One year of training with FES has impressive beneficial effects in a 36-year-old woman with spinal cord injury, *J Spinal Cord Med.* vol. 40, pp. 107-112, 2017
- [4] www.3-x-f.com