FORSCHUNGSBERICHT

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Neuromuscular Control of Hair Combing in Healthy Subjects and Stroke Patients. An Approach for Functional Biofeedback Training

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NEUROMUSCULAR CONTROL OF HAIR COMBING IN HEALTHY SUBJECTS AND STROKE PATIENTS. AN APPROACH FOR FUNCTIONAL BIOFEEDBACK TRAINING.

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INTRODUCTION

EMG-biofeedback has been used since the late 1960s in the rehabilitation of stroke patients. The theoretical objective is that undamaged, yet subliminal pathways can be recruited and assume the function of pathways that were irreversibly damaged (1).

Although EMG studies in rehabilitation are widespread, there is a lack of data with respect to functional neuromuscular activation in daily living activities. Thus, no norm data are available to compare with patients data. Therefore, the aim of this study is

- to examine the neuromuscular control of hair combing in healthy subjects as a basis for biofeedback-training,
- to implement the results in an approach for functional biofeedback-training.

METHODS

The current study included 13 healthy subjects (height: 173.45±7.55 cm, weight: 64.36±12.35 kg, age: 23.72±3.52 years) without any neurological or orthopaedic disorders. Subjects were asked to perform a hair combing movement 3 times. The hair combing movement was divided into 7 phases: 1) move the arm cranial, 2) combing movement from anterior to posterior of the middle part of the head, 3) return, 4) combing movement of the left side of the head, 5) return, 6) combing movement of the right side of the head, 7) return to starting position.

We recorded surface electromyograms (sEMG) of the m. trapezius pars ascendens (LT), m. trapezius pars descendens (UT), m. trapezius pars horizontalis (MT), m. serratus anterior (SA), m. biceps brachii (BB), m. deltoideus pars ventralis (AD), m. deltoideus pars middle (MD), and m. deltoideus pars dorsalis (PD) using NORAXON® Telemyo 2400T. Signals were A/D converted with 1500 Hz and stored in MyoResearch XP software followed by ECG reduction, full wave rectification, smoothing with RMS 100 ms and amplitude normalization to the highest activity level during maximum voluntary contraction (MVC) detected from 8 different MVC tests. 2D kinematics were obtained synchronously using NORAXON® software. The recordings of the arm in the frontal plane were re-sampled to 1500 HZ and analyzed by SIMI Motion (build 275). To investigate the highest EMG activity in different phases of the hair combing cycle, a two-way-ANOVA (phase, muscle, interaction phase x muscle) with a Holm-Sidak correction was performed.

RESULTS

The statistical analysis revealed that there is a significant main effect for the identified phases and the recorded muscles (respectively $F_{6,672}$=25,0, p<0.001; $F_{7,672}$=37,0, p<0.001). However, the interaction 'phase x muscle' just did not pass the significant level of 0.05 ($F_{42,672}$=1,4, p=0.063). Post hoc analysis showed that with respect to the individual MVC of each muscle, the AD, the LT, and the SA have major contributions with respect to the hair combing movement and the defined phases (see table 1, figure 1).

DISCUSSION AND CONCLUSION

The data of the current study provide insights into the neuromuscular control of hair combing. With respect to the biofeedback training, the current results present a first baseline of functional training in EMG biofeedback for a daily life activity of stroke patients. Possible training parameters like the contribution of the different muscles and the coordination of the muscles, especially AD, LT, and SD, can be dedicated for biofeedback-training. In future studies, the database will be extended to include more (older) subjects. Moreover, the evaluation of the EMG-biofeedback training will be finished.

Tab. 1: Maximum mean sEMG activity of the recorded muscles with respect to the 7 different phases (in % MVC).

Phase			
	Muscle	**Mean MVC**	**SD MVC**
Phase 1	AD	21.7	14.1
Phase 2	LT	28.1	14.7
Phase 3	AD	27.8	10.3
Phase 4	SA	35.2	19.1
Phase 5	LT	21.4	11.5
Phase 6	LT	19.8	11.9
Phase 7	LT	6.7	6.9

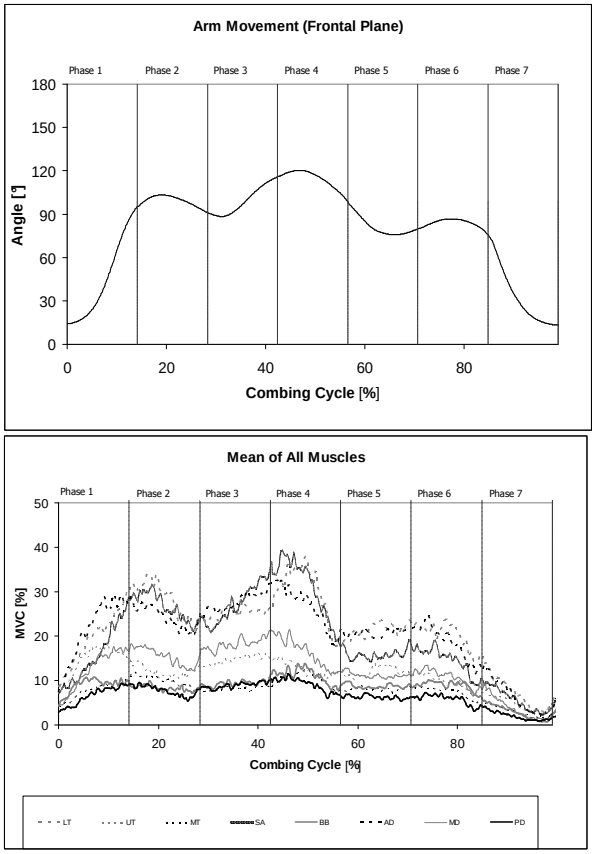

Fig. 1 a and b: Arm movement in the frontal plane (mean) and mean sEMG of the recorded muscles during the hair combing movement (n=13, average of three repetitions)

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