



Combined electrophysiological stimulation and visual-exploration therapy in unilateral spatial neglect: Therapeutic implications.

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Introduction

Unilateral spatial neglect comprises a number of discrete symptoms including defective awareness of visual targets in the neglected sector of space. Therapeutic interventions include afferent electrophysiological stimulation via transcutaneous nerve stimulation (TENS), visual exploration training (VIS EX) and exposure to slowly moving stimuli that are thought to facilitate attentional directing responses to the left hemispace (optokinetic stimulation, OKS). Recent studies imply that respective interventions result in considerable reduction of neglect symptoms. However, the remission of neglect symptoms is rarely complete and residual deficits undermine independence in activities of daily living. Further, the application of TENS-stimulation is limited when the training candidate reports aversive sensations resulting from the above-threshold current intensity. The MESH-Glove™ may represent an alternative to overcome this problem: It allows the activation of the sensory cortex through application of subthreshold current intensities to the contralateral hand [1]. Starting with the hypothesis that activation of perilesional tissue via MESH-Glove™ may induce beneficial effects on neglect symptoms and that combination of therapeutic techniques may bear additional positive effects on visuo-spatial neglect, we contrasted combined electrophysiological and visual-explorative therapy using TENS vs. MESH-Glove™.

Method

25 postacute patients with visual hemi-neglect after right-sided CVA received 12 training sessions. Each training session comprised visual exploration therapy (VIS EX) that consisted of 5 min. optokinetic stimulation (OKS), 20 min. visual search tasks (ELEX) and 5 min. OKS. 20 patients received additional electrophysiological while performing VIS EX. 10 individuals received TENS (TENS+VIS EX; see Fig. 1+2), 10 MESH-Glove™ stimulation (MESH+VIS EX; see Fig. 3+4). 5 control patients performed visual exploration therapy (VIS EX) alone.

TENS + VIS EX



Fig. 1: Optokinetic stimulation (OKS) + transcutaneous electrical nerve stimulation (TENS) at the contralateral neck. OKS: 50 randomised squares (height: 5x5 pixels) moving at low velocity (7,5"/sec.) from right to left.



Fig. 2: ELEX-training plus transcutaneous electrical nerve stimulation (TENS). 2-channel stimulation device (100 Hz, pulse width: 100 µs). Above-threshold stimulation at > 1 mA.

MESH + VIS EX

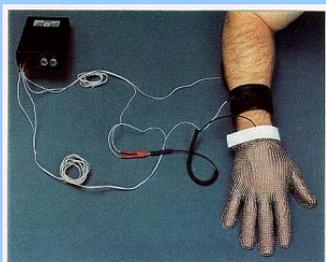


Fig. 3: MESH-Glove (MESH). 2-channel stimulation device (50 Hz, pulse width: 250 µs). Subthreshold stimulation at 0,9-1 mA.



Fig. 4: ELEX-training plus MESH-Glove-stimulation (MESH).

Visuo-explorative behaviour was assessed at four times using neuropsychological standard diagnostic tests (i.e. „Neglect“-subtest of the TAP [5], subtests 1-5 of the NET [6]). A katamnestic assessment was performed in some volunteers six weeks after termination of the stationary therapy .

Results

Both therapeutic interventions TENS+VIS EX and MESH+VIS EX significantly decreased inattention to the left hemispace in our patients suffering from CVA and the improvement in both experimental groups was higher than in our control patients who received VIS EX without additional electrophysiological stimulation (see Fig. 5+6).

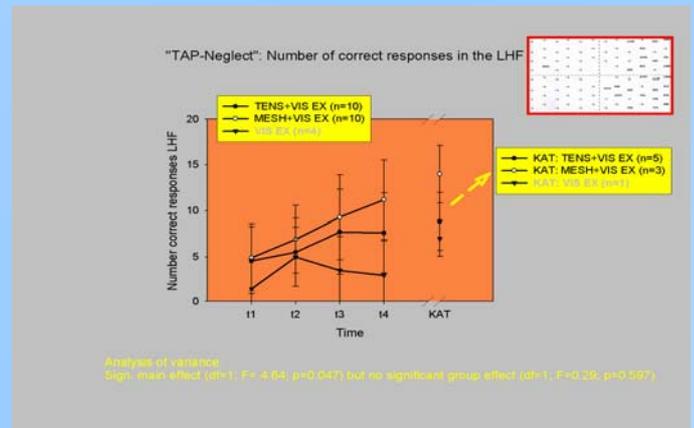


Fig. 5: „TAP-Neglect“: Detected stimuli in the left hemifield in dependency on the type of therapeutic treatment.

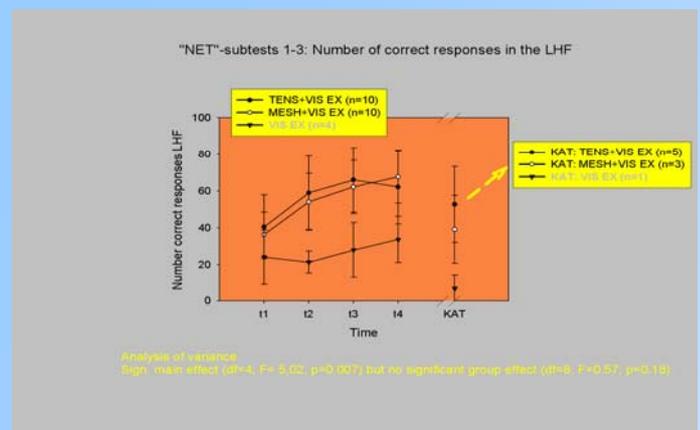


Fig. 6: „NET“-subtests 1-3: Detected stimuli in the left hemifield in dependency on the type of therapeutic treatment.

Conclusion

Combined electrophysiological stimulation plus visual exploration training seems to facilitate recovery from unilateral visual neglect for the left hemispace in postacute stroke patients even with comparatively low therapy frequency. We thus feel encouraged to favour MESH-Glove™-stimulation in the treatment of neglect in our clinical setting because:

- the MESH-Glove™ has got the potentiality to stimulate with currents lying below the threshold of subjective detectability
- the pathway of modulatory effect on cortical activity seems to be more evident for MESH-Glove™ stimulation in comparison to TENS

Future research will have to clarify the proportion of interfering variables on changes in psychometric tests as we found in the present study. These may consist in test repetition effects and spontaneous remission. The description of precise dose-response-relationships may be helpful in planning future cognitive therapy programs.

Literature

- [1] Cicerone, KD et al.: Arch. Phys. Med. Rehab., 2000,81: 1479-95. [2] Kerkhoff, G.: Neglect und assoziierte Störungen. Göttingen, 2004: Hogrefe. [3] Rustenbach, SJ et al.: Z. Neuropsych., 2000,11:23-51. [4] Golaszewski, S et al.: Neurol., 2004,62:2262-9. [5] Zimmermann, P & Fimm, B: Testbatterie zur Aufmerksamkeitsprüfung (TAP). Freiburg, 1992: Psytest. [6] Zihl, J & Kerkhoff, G.: ELEX-Handbuch. München, 1987.