

Stimulation of the proprioceptive System in SCI patients

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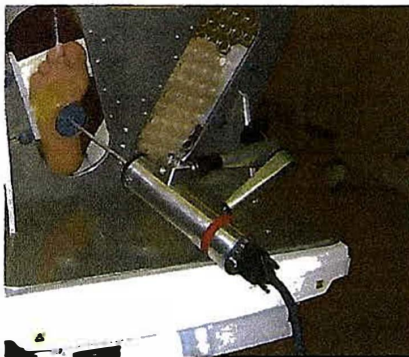
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Introduction: Functional magnetic resonance imaging (fMRI) is a promising tool for the mapping of the sensorimotor cortex suitable for the assessment of a large variety of neurological and neurosurgical indications. Active motor paradigms such as finger-to-thumb or foot tapping are not appropriate for the functional assessment of the sensorimotor network in case of paretic or plegic extremities. The aim of the study was to map in detail the cerebral structures that exhibited changes of the BOLD (blood oxygenation level dependent) response during vibrotactile stimulation (VTS) for the application in SCI patients.

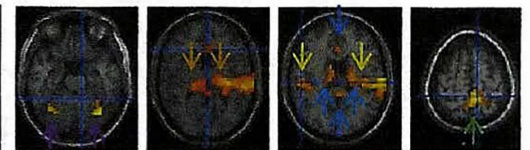
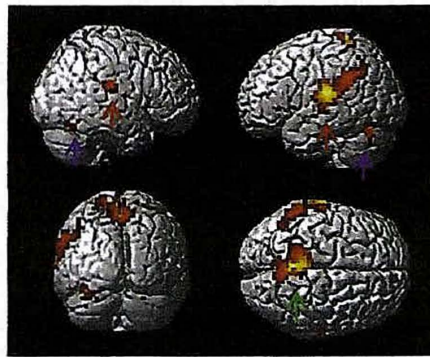
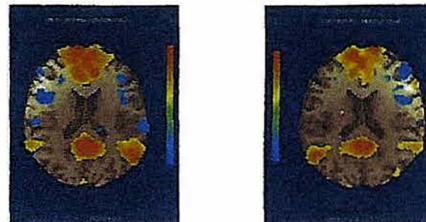
Materials and methods: 40 Patients with SCI and hand muscles motor activity with at least grade 1 will be recruited for this single blinded, randomized study. They will be divided in two equal sized groups, verum and sham group. MGS will be applied on the paretic hand(s) daily for 60 min before the standard rehabilitation training over three weeks. The hand motor and sensory functions will be evaluated with Wolf Motor Function test, Fugl-Meyer Assessment score, Nine hole peg test, and Semmes-Weinstein monofilaments. Single and paired-pulse transcranial magnetic stimulation (TMS) will be applied to follow the corticospinal excitability changes over the treatment period. Further, functional magnetic resonance imaging (fMRI) will be conducted to assess the cortical brain reorganization changes after the treatment. Effects of VTS will be compared to control group receiving sham stimulation.



Subcortical structures

1. Bilateral Thalamus (somatosensorische Kerne), kontralateral Nucleus lentiformis
2. Bilateral Nucleus caudatus

Modulation of Default Mode Network (DMN):



Cortical structures

1. Bilateral S2 (parietal inferior), contralateral temporal superior
2. Bilateral Cerebellum (Culmen, Declive)
3. Contralateral SM1, bilateral parietal superior
4. Bilateral Gyrus cinguli anterior und posterior
5. Bilateral Inselärer Kortex, posterior parietal (linksdominant)

Results: The contrast vibrotactile stimulation versus baseline (no stimulation) revealed activation within the secondary somatosensory cortex S2, the inferior parietal lobule (BA 39 contralaterally, 40 and 43 bilaterally), the superior parietal lobule (precuneus, BA 5 and 7 bilaterally with a dominance of the left side), the anterior and posterior cingular gyrus (BA 23, 24, 29, and 31 bilaterally), and the left posterior insula (BA 13). Additional activation was observed bilaterally within the thalamus and caudate nucleus as well as the anterior (culmen) and posterior (declive) cerebellar lobe. Activation within the thalamus included the pulvinar, the lateral dorsal nucleus, the lateral posterior nucleus, the midline nucleus, the ventral posterior lateral nucleus, the ventral posterior medial nucleus, and the ventral lateral nucleus. Contralaterally to the stimulated foot, responses within the primary sensorimotor cortex including the pre- and postcentral gyrus (SM1; BA 1, 2, 3a, 3b, 4) and the lentiform nucleus were seen (see Table 1, Fig. 2).

Conclusion/Discussion: VTS applied to the sole of the foot elicits a wide network of cortical sensorimotor centers, especially of the proprioceptive system that should raise the motor cortical excitability in the cortex corresponding to the injured spinal tracts so that motor command should be easier conducted. The expected conditional effect of WAES should make subsequent physiotherapy more effective.

References

- [1] Golaszewski et al.: Human Brain Structures related to plantar vibrotactile stimulation: a fMRI study. *NeuroImage* 2006; 29: 923-929.
- [2] Li Chenxuan et al.: Enhancing of Resting-State fMRI networks by Prior Sensory Stimulation. *Brain* 2014;18: 1-26.



Spinal Cord Injury & Tissue Regeneration Center Salzburg

Summit 2015

Paracelsus Medizinische Privatuniversität, Haus C
9 am - 6 pm

Keynote Lecture: Prof. Merab Kokaia, Lund University

Topics:

- Optogenetics
- Stem Cells: Where are we now in human application?
- SCI: pre-clinical Trials
- Tissue- and Neuroregeneration
- Neuroplasticity, Neurostimulation
- Brain-Computer Interfaces
- Neurorehabilitation

Programme:

- Best Abstracts as Oral Presentations
- Poster Presentation and Awards
- Social Get-Together (7 pm)

Registration:

Email to: scitreCs.summit2015@pmu.ac.at

Subject: Registration.

No registration fee.

Abstract Submission:

For oral presentation or poster (max. 300 w)

via email: scitreCs.summit2015@pmu.ac.at

Submission deadline: September 5, 2015.

Organisation: Prof. E. Trinka and SCI-TReCS Team, Dept. of Neurology