Mapping of the sensorimotor cortex with functional magnetic resonance imaging (fMRI)

F. Gerstenbrand [1,2] S.M. Golaszewski [3], C.M. Siedentopf [4], W. Struhal [5], I. Koslovskaya [6]

[1] Karl Landsteiner Institut for Restorative Neurology and Neuromodulation, Vienna, Austria
[2] Department of Neurology, Medical University, Innsbruck, Austria
[3] Department of Neurology, Medical University, Salzburg, Austria
[4] Department of Radiology II, Medical University, Innsbruck, Austria
[5] Department of Neurology, General Hospital, Linz, Austria
[6] Institute for Biomedical Problems, Moscow, Russia

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Purpose:

- FMRI of the sensorimotor cortex in neurological patients is often difficult to perform because of impairment of motor functions, hemiparesia or hemiplegia.
- Therefore, the fMRI evaluation of sensory stimulation would be of great importance, because the collaboration of the subject under examination is not needed.

Purpose:

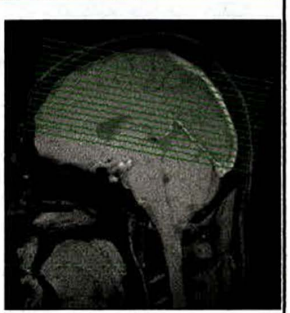
- Sensory stimulation by vibration has already been performed in PET studies, which have shown, that vibration stimulation activates the somatosensory as well as the motor cortex (Seitz et al., Acta Neurol Scand, 1992).
- Aim of the study: Implementation of a vibratory stimulation paradigm within the MR environment, which leads to sensorimotor brain activation.

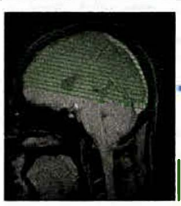
Overview

- Experimental Design
- Vibration Devices and Sensorimotor Brain Maps
- Clinical Applications

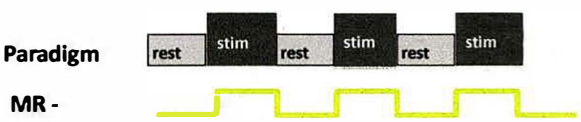
FMRI Data

- 1.5 Tesla Siemens Magnetom Vision
- Echo Planar Imaging (EPI)
- TR/TE/α = 1.68ms/64ms/90°
- No. Slices = 30 (whole brain)
- parallel to AC-PC line
- 90 images / slice,
- time resolution 3 sec
- spatial res. = 2 x 2 x 3.8 mm
- Slice Thickness = 3 mm
- gap 0.25 oder 0.5
- Postprocessing: SPM99 (FIL, London)



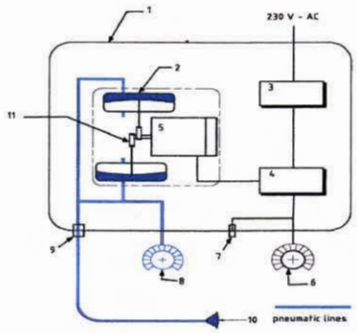


Block-Design

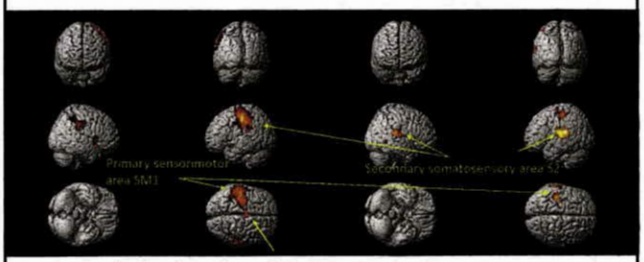


Postprocessing: SPM99

Pneumatic Vibration Device:



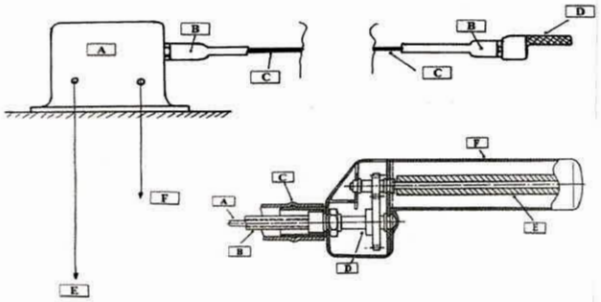
Fingertapping vs. Vibration (Golaszewski et. al, Neuroscience Letters, 2002)



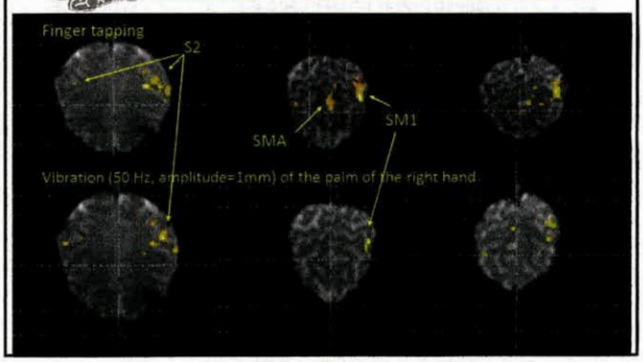
Finger tapping right hand

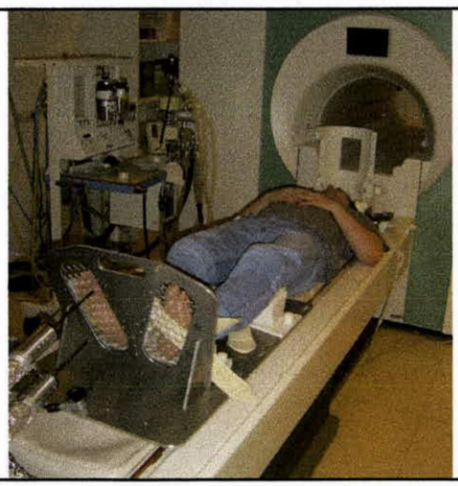
Vibration (50 Hz, amplitude=1mm) palm of the right hand

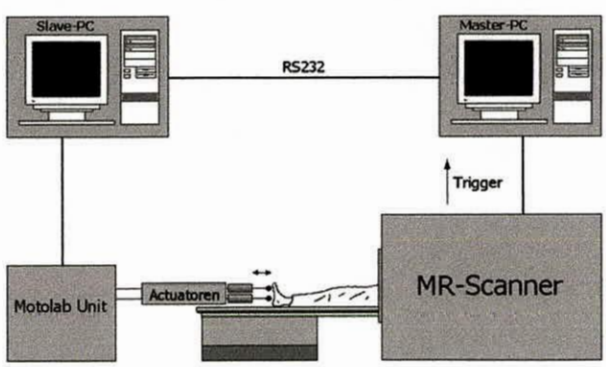
Mechanical Vibration Device:

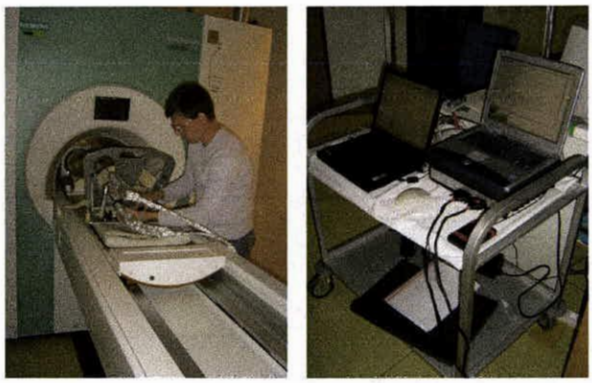


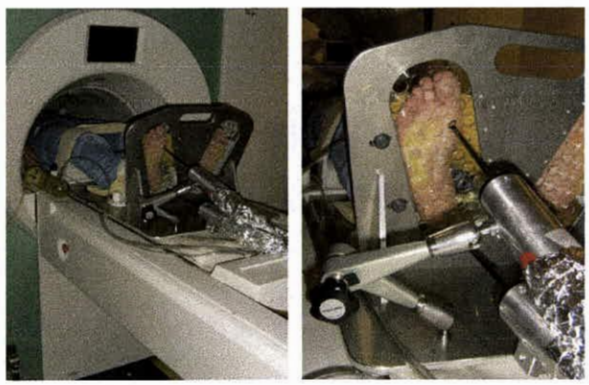
Finger tapping vs. Vibration (Golaszewski et al., NeuroImage, 2002)

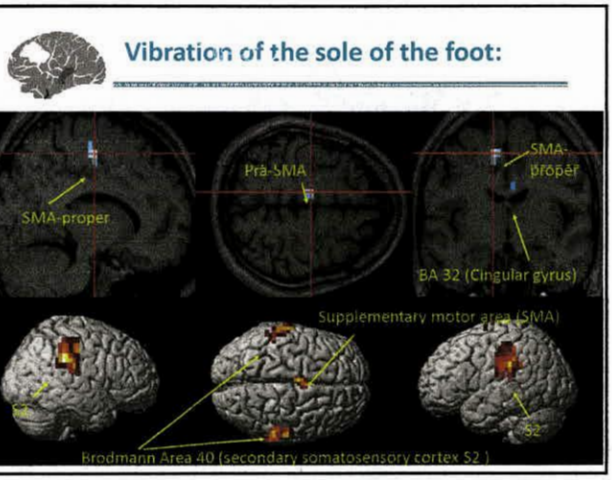


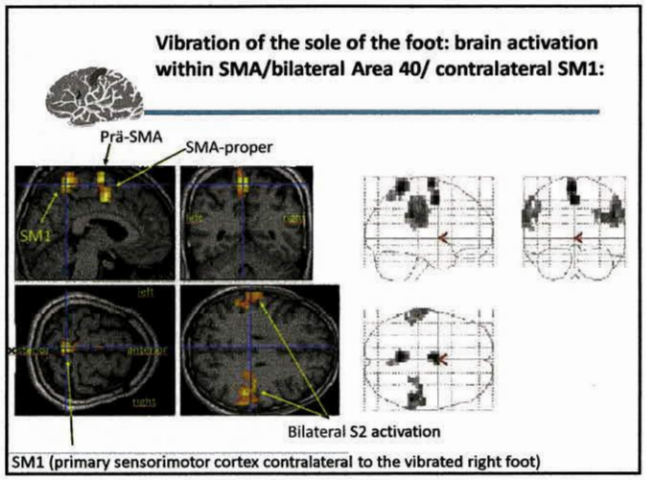






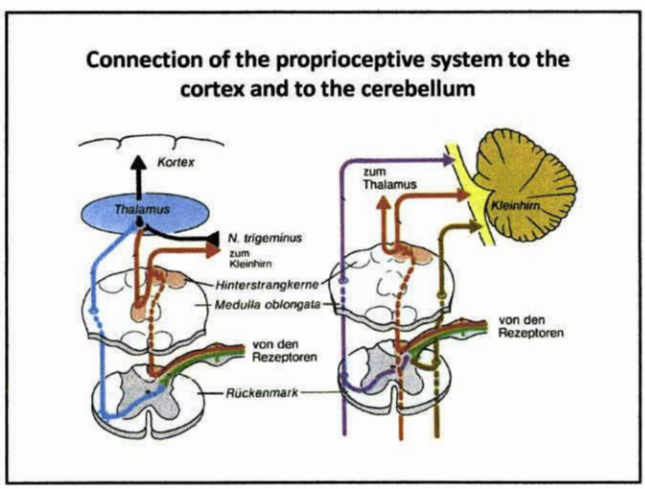




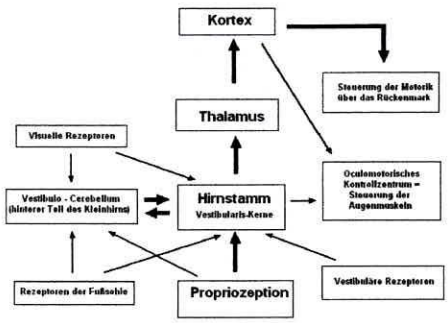


Results:

- **Vibratory stimulation of the hand palm and the sole of the foot revealed robust contralateral activation within the primary sensorimotor cortex (SM1), bilateral activation within the secondary somatosensory cortex (S2, Brodmann Area 40), bilateral within the supplementary motor area (SMA, BA 6) and ipsilateral within the cingulate gyrus (BA 32).**



Scheme of proprioceptive connections to the cortex



Clinical Application

- Peripheral Neuropathy
- Spinal Cord Injury
- Prognosis in Brain Injury (coma, brainstem lesions, midbrain syndrome, apallic syndrome)
- Bed rest syndrome
- Space disease

Discussion:

- Passive sensory stimulation by a vibratory stimulus to the hand palm and the sole of the foot leads to activation within the whole sensorimotor cortex like in active motor paradigms such as finger-to-thumb or foot tapping

Discussion:

- This holds promise for the vibratory stimulation as an alternative to active motor paradigms in neurological patients with severe motor deficits to study sensorimotor cortex functions in patients with brain pathology or pathology of afferent pathways for functional diagnosis, prognosis and monitoring of rehabilitation.