

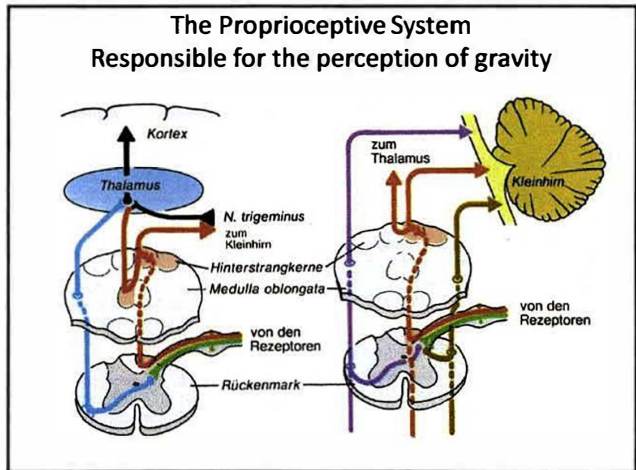
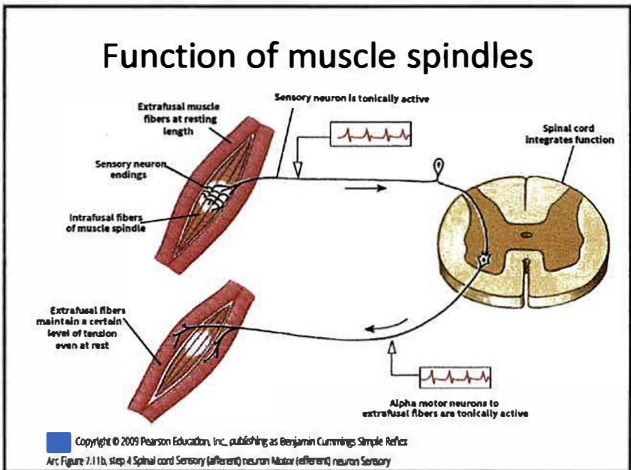
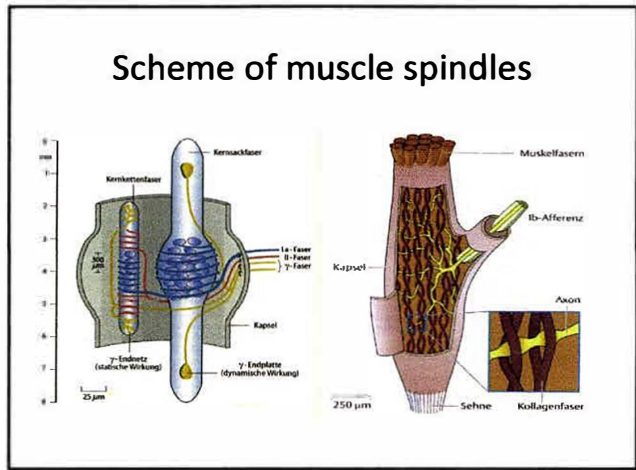
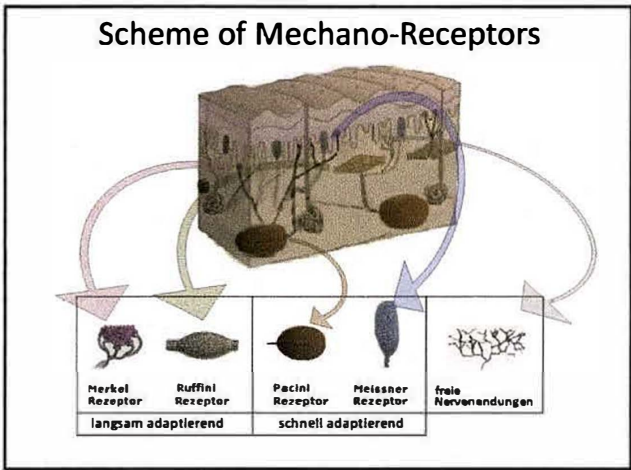
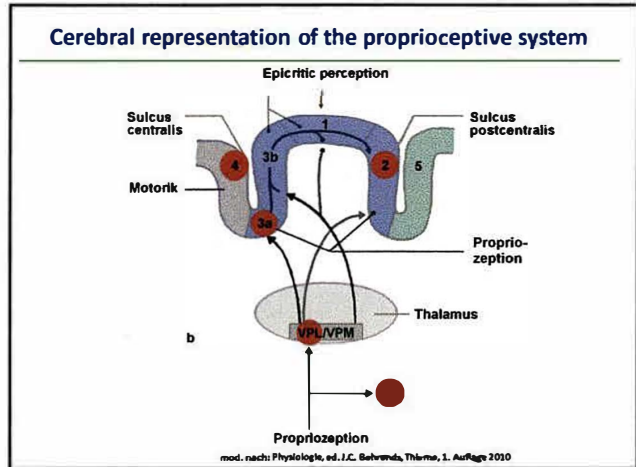


## Stimulation of the Proprioceptive System in Neurology

F. Gerstenbrand <sup>1)</sup>, S.M. Golaszewski <sup>1), 2)</sup>, M. Seidl <sup>2)</sup>,  
 A.B. Kunz <sup>2)</sup>, Ch. Kurzmann <sup>1)</sup>, E. Trinkla <sup>2)</sup>

<sup>1)</sup> Karl Landsteiner Institute for Neurorehabilitation and Space Neurology, Vienna,  
<sup>2)</sup> Neurological Clinic of the Paracelsus Medical University, Salzburg, Austria

**44<sup>th</sup> International Danube Neurology Symposium**  
 7-9 th June, 2012  
 Szeged, Hungary,



### Stimulation of the proprioceptive system

- **Passive limb movements**
  - Evidence: Shibasaki et al, Brain, 1999 (PET)
- **Electrical stimulation**
  - Evidence: Golaszewski et al, Neurology, 2004 (Mesh Glove/fMRI), Clin. Neurophysiol 2010, 2011 (Mesh Glove/TMS)
- **Vibration**
  - Evidence: Golaszewski et al, NeuroImage, 2002, 2006 (hand and foot vibration/fMRI)

### Stimulation of the proprioceptive system to enhance motorcortex excitability

### Stimulation Methods with different Devices

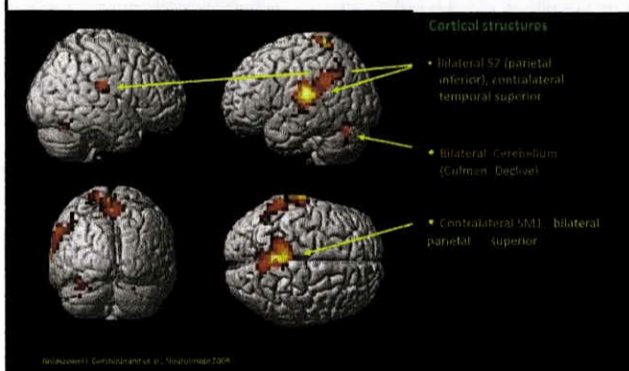
- Vibro Stimulation Shoe
  - Austrian Model
  - Russian Model
- Swiss Swing Method (rotational vibration)
- Mesh Glove / Mesh Socks-System
- Galileo System

Vibration to the foot sole: amplitude 1 mm, frequency 50 Hz



### Foot vibration

Group (n=10): amplitude = 1 mm, frequency = 50 Hz



### Further cortical structures

- Bilateral Gyrus cinguli anterior and posterior

- Insular Cortex: posterior parietal (left-dominant)

### Subcortical structures

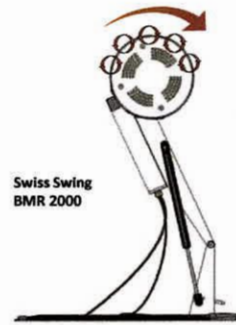
- Bilateral Thalamus (somatosensory nuclei), contralateral Nucleus lentiformis

- Bilateral Nucleus caudatus

Golaszewski, Gerstenbrand et al., NeuroImage 2006

## Methods for Vibrating Stimulation

### Swiss Swing System



Swiss Swing  
BMR 2000

stimulation frequency: 25 Hz  
stimulation amplitude: 4 mm  
stimulation duration: 20 min



### Pressure shoe – Austrian model



Used in:

long-lasting coma states  
(intensive care units)

Locked-in syndrome

Apallic syndrome

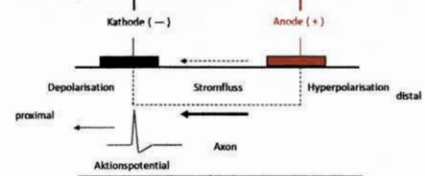
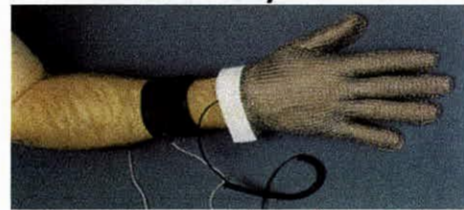
Severe stroke defects

Severe states after  
traumatic brain injury

Planned:

Geriatric institutions

### Mesh Glove System



### Effect on Proprioceptive System Intracortical Modulation

- Intracortical Facilitation (ICF) increased
  - Intracortical Inhibition (ICI) reduced
  - No Spinalcord Modulation
- F-Waves unchanged

### Stimulation Methods of the Proprioceptive System 1)

#### Vibrostimulation Shoe

Exitability of corresponding sensorimotor area

- Stimulation Time 20 Min.
- Stimulation Frequency 10 Hz
- Stimulation Amplitude 2 mm
- Lasting Neuromodulation Effect 120 Min.

#### Vibration Stimulation Swiss Swing Method

Exitability of corresponding sensorimotor area

- Stimulation Time 20 Min.
- Stimulation Frequency 25 Hz
- Stimulation Amplitude 4 mm
- Lasting Neuromodulation Effect 120 Min.



## Stimulation Methods of the Proprioceptive System 2)

- Mesh Gloves/Mesh Socks Stimulation  
Mixed Form with additional electrical stimulation  
Exitability of corresponding sensorimotor area
- Stimulation Time 30 Min.
  - Stimulation Frequency 50 Hz
  - Stimulation Amplitude 2-4 mA
  - Lasting Neuromodulation 120 Min.

## Effect of Stimulation Methods on Proprioceptive System

- Activation of motor cortex  
- (Treadmill exercises, special exercises legs and arms, Target Training, Electro Trousers, Penguin Suite)
- Enhancement of sensorimotor area  
- Vibrostimulation Shoe, Swiss Swing Method, Mesh Glove/Mesh Socks System
- Lasting Neuromodulation in combination with TMS  
- Mesh Glove/Mesh Socks System
- Activation of Cerebellar System  
- Swiss Swing Method, Galileo System

## Counter Measures in Real Microgravity for Cosmonaut Disease

- Treadmill exercises
  - Daily fixed program
- Special exercises legs and arms
- Adaptation of fine motor skills
  - Target training
- Adaptation training of cognitive functions
- Electro trousers
- Penguin suit

## Space Counter Measures used in Neurorehabilitation

- Motor disturbances (Parkinson Syndrome, spasticity, cerebellar disturbances, disturbances of the peripheral nerve system)
- Apallic syndrome, Locked-in syndrome
- Severe defect after stroke (motoric disturbances, cognitive failures etc.)
- Severe defects after traumatic brain injury
- Prevention of bedrest syndrome
- Dementia

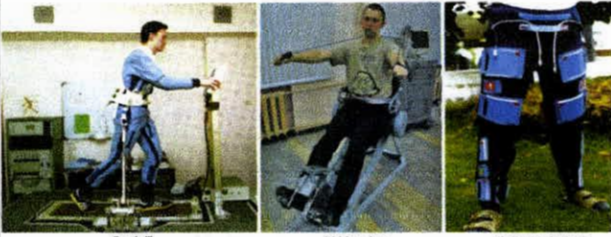
## Bedrest Syndrome

- Primary muscle atrophy with muscular changes and structural lesions
- Changing in muscle enzymes
- Polyneuropathy
- Proprioceptive disturbances (spinal ataxia, deep sensation disturbances)
- Thalamic symptoms
- Decrease in vigilance
- Cognitive disturbances
- Body scheme disturbances
- Osteoporosis

## Different Devices as a Spin-off effect of Space Neurology

- Pressure shoe – Austrian model
- Pressure shoe – Russian model
- Korvit System – Foot loading imitator
- Regent – treatment suit
- Penguin System
- Adeli System

## Neurorehabilitation Methods



Treadmill

Weight trainer

Electromyostimulator

### Prevention tools for space mission

Used in:  
minimal neurological disturbances (spasticity, cerebellar disturbances, Parkinson Disease, polyneuropathy, early dementia state)  
Geriatrics, wellness

## Korvit - Foot loading imitator, Russia Imitating gait movement



Used in:  
Gait disturbances; Parkinson's Disease; Spasticity, different origin;  
Spinal cord lesions; Polyneuropathy;

Planned: Dementia, Geriatric institutions



## Regent – Treatment Suit



Used in  
Spasticity  
Parkinson's Disease  
Spinal cord lesions  
Polyneuropathy  
Stroke, severe defects

Planned In:  
Dementia, Geriatric

## Penguin suit



Used in:  
Cerebral palsy  
Spastic spinal paralysis

Planned:  
Parkinson's Disease  
Dementia



## ADELI-SYSTEM



Used by:  
Cerebral palsy  
Spinal cord lesion  
Stroke  
Vertebral spine disturbances

Planned:  
M. Parkinson  
Dementia



Source: ADELI Folder

## Additional Methods in Neurorehabilitation: Partial microgravity in underwater position

- Scuba Diving - 4-5m depth
- Scuba Diving - 20-30m depth
- Scuba Diving in underwater tower
- Snorkel-Diving-System

## Scuba Diving in depth 4 - 5 m



Precondition:  
Always in pairs  
with special  
trained physio-  
therapist

## Stimulation of the Proprioceptive System is a basic tool in Neurorehabilitation

Indication:

- Central deficits (extra pyramidal symptoms, ataxia, spasticity – not fully controlled )
- Deficits of higher brain functions (aphasia, alexia etc.)
- Deficits of highest brain functions (frontal syndrome, temporo-basal syndrome)
- Lesion of peripheral nerve system.
- Neuro-muscular diseases.
- Bed Rest Syndrome
- Vertebral Spine disturbances



8<sup>TH</sup> JUNE (FRIDAY)

**Special Guest Session**

**Chairs: Bereczki, D. (Budapest) and Tajti, J. (Szeged)**

- 9.00-9.20 X Gerstenbrand, F., Golaszewski, St., Kunz, A., (Vienna, Salzburg):  
Stimulation of the proprioceptive system.
- 9.20-9.40 Baloyannis, S. (Thessaloniki):  
The hypothalamus in Alzheimer's disease: a morphological study.
- 9.40-10.00 Kadanka, Z. (Brno):  
Treatment of the spondylotic cervical myelopathy: prospective  
randomised study.
- 10.00-10.20 Coffee break
- Multiple sclerosis**  
**Chairs: Kieseier, B. (Düsseldorf) and Vécsei, L. (Szeged)**
- 10.20-10.50 Ebers, G. (Oxford):  
Life expectancy in multiple sclerosis.
- 10.50-11.20 Kieseier, B. (Düsseldorf):  
Novel therapeutic strategies of multiple sclerosis.
- 11.20-11.35 Komoly, S. (Pécs):  
Fate of oligodendrocytes in human and experimental demyelination.
- 11.35-11.50 Klivényi, P. Vincze, O., Oláh, J., Szalárdy, L., Zádori, D., Vécsei, L., Óvádi, J.  
(Szeged, Budapest):  
New biomarker in multiple sclerosis.
- 11.50-12.00 General discussion
- 12.00-13.00 Lunch

# 44<sup>th</sup> INTERNATIONAL DANUBE NEUROLOGY SYMPOSIUM



50<sup>TH</sup> ANNIVERSARY OF THE DONAUSYMPOSIUM:  
1962, VIENNA - 2012, SZEGED

**7-9. JUNE, 2012.**  
**SZEGED, HUNGARY**  
PROGRAMME