Modern Devices in Neurorehabilitation, Spin off-Effect of Space Neurology

F. Gerstenbrand[1), 2)], Vienna
St. Golaszewski [1), 2),3)], Salzburg
[1)] Austrian Society for Aerospace Medicine ASM, Vienna
[2)] Karl Landsteiner Institute for Neurorehabilitation und Space Medicine, Vienna
[3)] Department for Neurology, Christian Doppler Clinik, Salzburg

Press Conference
Opening of Wechselland Academy
and Spin-Off companies from ASM
Onkotec GmbH Science & Research Marketing GmbH

19. März 2009

ONKOTEC GmbH

WELAAK WECHSELLAND ACADEMY

S&R Science and Research Marketing GmbH

First Intentions: Military Space Flight

MIR in space,
destroyed March 23rd 2001

Launch of Soyuz TMA-5

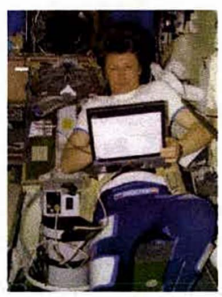
Space life at MIR

Austrian cosmonaut Franz Viehböck with
Russian crew at MIR

Counter Measures in Real Microgravity

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

Counter Measures Real Microgravity



Cosmonauts counter measures:
Electrode trousers, stimulation
of muscle receptors

Penguin-Suit, carried several hours per day. Every movement has to be carried out against resistance of the suit.

Simulated microgravity

Ground based laboratory
Special equipment necessary

- Methods
  - Bedrest system
    - Head down tilt-system – HDT
  - Body weight discharge
  - Dry water immersion model – DWI-method

Simulated microgravity

Dry water immersion model – DWI-method

DWI institution, Innsbruck, Neurospace Institute, 2 healthy volunteers, 48 hours experiment

DWI experiment, healthy volunteer lifted out for showering

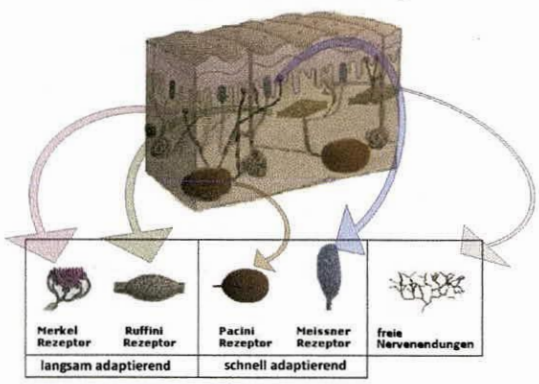
Space Neurology

- Research aim: influence of microgravity
  - Real microgravity
    - Influence on the proprioceptive system
    - Influence on the vestibular system (otolith system)
  - Simulated microgravity, ground based laboratory
    - Influence on the proprioceptive system
- Use of the research results in neurology
  - Neuro-diagnosis
  - Neurorehabilitation
- Development of new methods and new devices
  - Acute neurology
  - Neuro-rehabilitation

Bedrest Syndrome
Developed in Simulated Microgravity

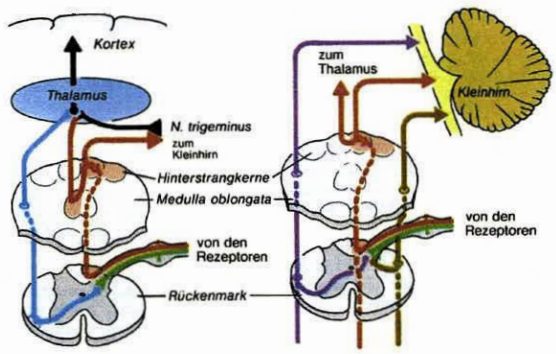
- Primary muscle atrophy with muscular changes and structural lesions
- Changing in muscle enzymes
- Polyneuropathy
- Proprioceptive disturbances (spinal ataxia, deep sensation disturbances)
- Thalamic symptoms
- Decrease in vigilance
- Cognitive disturbances
- Body scheme disturbances
- Osteoporosis

Scheme of Mechano-Receptors



The Proprioceptive System

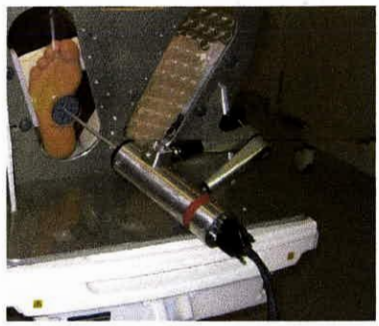
responsible for the perception of gravity



Experimental Verification
influence of foot sole vibrostimulation

- Functional MRI (fMRI) in healthy volunteers
  - Proof of BOLD-effect (Blood oxygenation level dependent) main focus on activities in centers of the postural system (sensomotoric center), cerebellum
  - Other foci on frontal lobe, temporal lobe, thalamus, cingulate gyrus, inferior parietal lobe

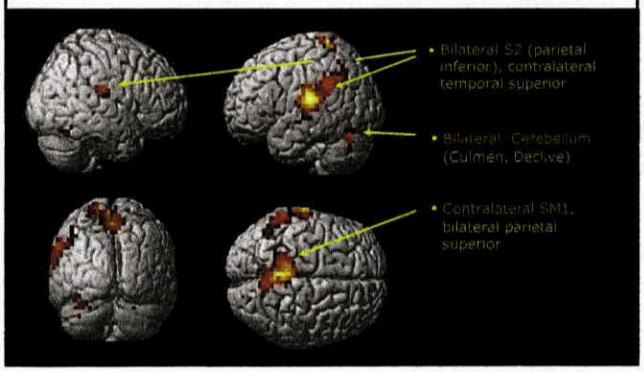
Vibrotactile Stimulation of the Foot Sole, Moving Magnet Actuator System



Vibration frequency 50 Hz

Stimulation of muscle spindles and Paccini-corpuscles

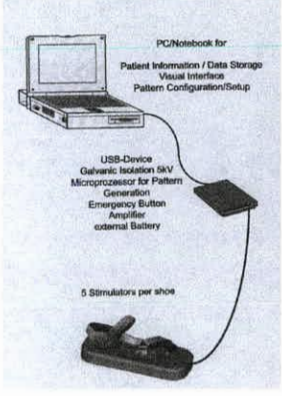
Result of vibro-stimulation of the foot sole in healthy volunteers



Different Devices as a Spin-off effect of Space Neurology

- Prevention tools for space missions (treadmill, weight trainer, trousers with electrostimulator)
- Pressure shoe – Austrian model
- Pressure shoe – Russian model
- Korvit System – Foot loading imitator
- Regent – treatment suit
- Penguin System

New Neuro-Rehabilitation Methods



Pressure shoe Austrian model

Used in:

long-lasting coma states (intensive care units), Prevention of bedrest syndrome

Apallic syndrome
Locked-in syndrome

Severe stroke defects

Severe states after traumatic brain injury

Planned: Dementia, Geriatric institutions

New Neuro-Rehabilitation Methods

Mechanical Stimulator, „Artificial Foot"

Russian model

Used in:
Prevention of bedrest syndrome (ICU)
Parkinson's Disease (mild form), spasticity (mild form), cerebellar symptoms, etc.

Source: Manned Mission to Mars, Russian Academy of Cosmonautics, 2006

New Neuro-Rehabilitation Methods

Korvit - Foot loading imitator

Used in:
Gait disturbances; Parkinson's disease; spasticity, different origin; spinal cord lesions; polyneuropathy

Planned: Dementia, geriatric institutions

New Neuro-Rehabilitation Methods

Regent Treatment Suit

Used in:

Spasticity
Spinal cord lesions

Parkinson's Disease

Polyneuropathy

Stroke, severe defects

Planned In:

Cerebellar ataxia, Dementia, Geriatric institutions

Space Neurology and Neurorehabilitation in Future

- Scientific programs focused on simulated microgravity methods
  - Detailed results in knowledge of the proprioceptive system and its influence to the highest and higher brain functions
  - New methods in neuro-diagnoses
  - New methods in neuro-rehabilitation
- Scientific program in real microgravity based on orbit flights, ISS
- Scientific program in partial microgravity in underwater conditions
- Combined programs with neuropharmacological methods

Wechsel wirkt
WIRTSCHAFTSPLATTFORM WECHSELLAND

UMWELT KOMPETENZZENTRUM
UKZ WECHSELLAND

EINLADUNG

zur Pressekonferenz am 19. März 2009

anläßlich der Gründung der

Wechsellandakademie

WELAAK
WECHSELLANDAKADEMIE

Die **Wechsellandakademie** ist als gemeinnütziger Verein konzipiert, dessen **Aufgabe es ist, in Zusammenarbeit mit dem UKZ** Forschern einen ruhigen Ort für bedarfsorientierte Seminare in allen Bereichen von Gesellschaft, Umwelt und Wirtschaft zu bieten. Das **Umweltkompetenzzentrum** ist nicht nur in der Nähe der Südautobahn, der A2, sondern auch über öffentliche Verkehrsmittel gut erreichbar.

Die Seminarräumlichkeiten sind hell eingerichtet und verfügen über eine multimediale Präsentationsausstattung. in den Seminarräumen. Ein hauseigenes, regionales Umweltlabor in dem div. Messungen durchgeführt werden können, runden das vielfältige Angebot ab. Besonders stolz ist die Wechsellandakademie auf die intakte Natur, die das Forschungszentrum umgibt.

Zum Thema Spin-off Effekte aus der Weltraumneurologie spricht Univ. Prof. Dr. Franz Gerstenbrand.

Die Firmen Science and Research Marketing GmbH sowie Onkotec Gmbh wurden zum Zweck der terrestrischen Anwendung von Weltraumexperimenten gegründet und gingen aus der Austrian Society for Aerospace Medicine – Life Sciences in Space hervor.

Zeit: 18:00 Uhr

Ort: Umweltkompetenzzentrum Schäffern, Dr. Karl Putz-Str. 1

S&R Science and Research Marketing GmbH

ONKOTEC GmbH