DEVELOPMENT AND IMPLEMENTATION OF SPACE COUNTERMEASURE TECHNOLOGIES IN TERRESTRIAL MEDICINE: PRESENT AND FUTURE

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Duration of space flights

Development of countermeasure system

- Yu. Gagarin: 108 minutes
- Gemini: 13 d 18 h
- Soyuz-9: 17 d 17 h
- Soyuz-17: 29 d
- Soyuz-9: 175 d
- V. Lyakhov
- V. Ryumin
- V. Titov
- M. Manarov: 366 d
- V. Polyakov: 438 d
- L. Kizim
- V. Solov'ev
- O. At'kov: 237 d
- M. Kornienko: 340 d
- P. Dubrov: 355 d
- D. Petelin: 370 d
- S. Prokop'ev: 370 d
- V. Titov
- M. Manarov: 366 d
- V. Polyakov: 438 d
- L. Kizim
- V. Solov'ev
- O. At'kov: 237 d
- M. Kornienko: 340 d
- P. Dubrov: 355 d
- D. Petelin: 370 d
- S. Prokop'ev: 370 d

Timeline:
- 1960
- 1965
- 1970
- 1975
- 1979
- 1985
- 1990
- 1995
- 2016
- 2022
- 2023
- 2023
- 2023

365 d
Aims of countermeasure system in space flights

Compensation for unloading of the motor system

ACTIVE MEANS:

• Treadmill (T-2)
• Veloergometer (VB-3)
• Resistive exercise device ARED

PASSIVE MEANS:

• Electromyostimulators
• Axial loading suit "Penguin"
• Occlusive cuffs
• Expanders
• Suit "Chibis" (LBNP)
• Anti-G suit "Centaur"
• Water-salt additives
SPACE TECHNOLOGIES IN TERRESTRIAL MEDICINE

Axial loading suit “Penguin”

Rehabilitation suit “Regent”

correction of functional disorders of posture and locomotions

increasing the quality of life

increase the tolerance to physical loads

increase of social activity
To date, the Institute’s technologies have been implemented in 350 institutions providing specialized preventive, therapeutic, and rehabilitation assistance to the population.

**REHABILITATION SUIT “REGENT”**

**SPACE PROTOTYPE**

**REHABILITATION SUIT**

Employees of the Institute of Biomedical Problems of the Russian Academy of Sciences and the Center for Aerospace Medicine and Technology - the authors and developers of the technologies being implemented - were awarded in 2009 the “National Prize for the Best Doctors of Russia “Challenge” for the creation of a new direction in medicine.

**Recovery after Stroke**

- **Healthy people**
- **Patients after an ischemic stroke.**
  - **Before training with "Regent" suit**
  - **After 14 days of training with "Regent" suit**
REHABILITATION SUIT “REGENT”

- A highly effective device for the rehabilitation of patients with: cerebral palsy, ischemic stroke, traumatic brain injury;
- Easily compatible with other neurorehabilitation technologies

- Correction of functional disorders of posture and locomotion,
- Increased the tolerance to physical loads,
- Improving the quality of life,
- Increased of social activity.

Clinical trial results (324 patients)

A virtual reality

Locomotor training with hanging

Balance therapy

Increased motor activity of the speech apparatus in all patients from the Regent group

Group "Regent"

Control group

* Significant change compared to the initial value, p<0.01
space technologies in terrestrial medicine

compensator of support unload KOR

all the stages of rehabilitation after stroke (including the acute period)

spinal pathologies

prolonged immobilization of patients of various nosological profiles

fractures of the bones of the lower extremities

noninvasive activation of areas of the cerebral cortex responsible for locomotions

normalization of muscle tone in the lower extremities

indirect prevention of venous insufficiency

activation of bone consolidation mechanisms
SPACE TECHNOLOGIES IN TERRESTRIAL MEDICINE

- relief of spasticity
- unloading of the musculoskeletal system
- reduction of chronic pain syndrome
- reduction of the depression level
- increase of immunity
- reduction of edematous syndrome
- reduction of peripheral vascular resistance

Ground-based microgravity model – Dry Immersion

- Dry Immersion bath for rehabilitation
A new “challenge” to modern society is hypodynamia and how it is related to adaptive changes in space.
ELECTROMYOSTIMULATION. DEVELOPMENT OF A COMBINED MODE.
PROTOCOL OF STIMULATION

What have we already done?

The design of the research

- **7-day Dry Immersion**
- **10 test volunteers**

**2 sessions per day** daily for 7 days of DI

The scheme of applying the electrodes **the same** for the two sessions

2 electrodes (with an area of 38.5 to 74.25 cm²) were applied to each stimulated muscle group:

- **Important!** it was the muscle group that was stimulated and not one specific muscle
- one electrode - to the distal extreme third of the muscle group
- the second – to the proximal extreme third of the muscle group
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