

**Changes in spatial and temporal parameters of arm movements in prolonged microgravity**

**M. Berger \* , S. Lechner-Steinleitner \* , I.B. Kozlovskaya # , F. Gerstenbrand \***

\*            Institute for Space Neurology, Innsbruck / Austria  
#            Institute of Biomedical Problems, Moscow / Russia

**Abstract**

Microgravity adapts movement control processes to the changed environmental conditions and alters spatial, temporal and kinematic parameters of pre-programmed movements. As a consequence, the efficiency and capacity of cosmonauts' work during space missions is reduced. Therefore it was important to investigate sensorimotor disturbances during the different flight phases and post-flight.

In 1991 the Austrian equipment MONIMIR was mounted on board the Russian space station MIR. Until 1996 it was used to study the influence of prolonged microgravity on eye-head-arm coordination and on the interaction of visual, vestibular and proprioceptive input. By three-dimensional recordings of head- and arm position and recordings of eye movements the reproducibility of movement patterns and their kinematic and spatial parameters were investigated before, during and after one short-term (7 days), eight long-term (4-8 months) and one super long-term (14 months) space flights on the station MIR.

One of the objectives of the MONIMIR experiments was to examine the influence of weightlessness on the condition of the spatial analysis system. Aimed arm movements in the horizontal plane (pointings towards two visual targets) were recorded, first with eyes open, head straight and then with eyes closed, head straight and during yaw or roll position of the head. A significant slant of the movement plane of the arm was found at defined head positions with eyes closed and interpreted as tilt of the internal representation of the horizontal coordinate. The effect was larger the greater the distortion induced by the changed head position, the larger the muscular involvement to keep the position and the more the remaining information was reduced (e.g. by microgravity).

Another topic was to examine motor short-term memory by reproducing memorized triangles, either learned by passive (only proprioceptive feedback) or active arm movements (visual and proprioceptive feedback)

The analyses of the data before, during and after flight revealed marked changes in motor programming shown as disturbances in motor patterns as well as in their spatial and temporal characteristics.

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