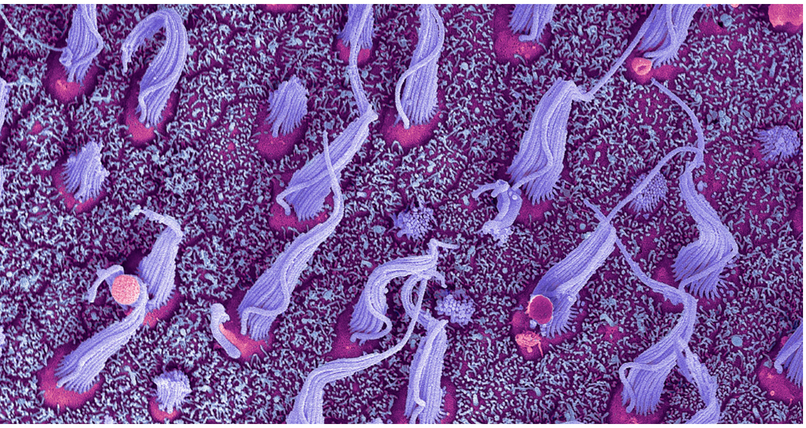

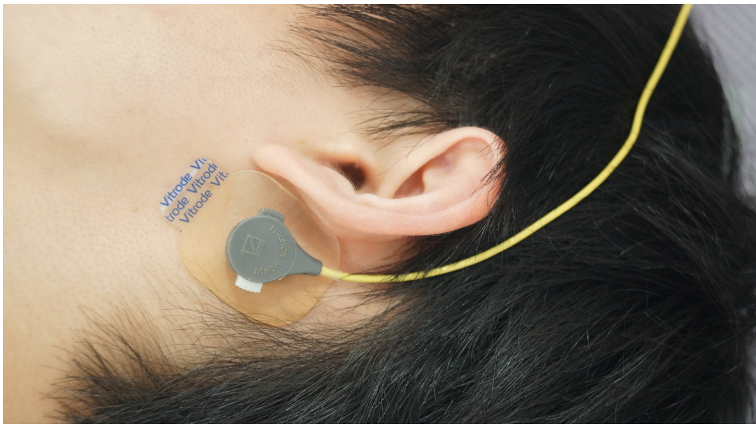

EXPLORING HOW MICROGRAVITY IMPACTS HUMAN HEALTH

A UNIQUE SPACE-MEDICINE PROGRAMME, offered by several Japanese universities, allows students the chance to solve issues related to our sense of balance in the inner-ear and muscle atrophy.

Released in 2022, NASA's *Moon to Mars* strategy lays out the first blueprint for sustained human presence and interplanetary exploration of the Solar System. However, these lofty ambitions are clouded by questions over the impact of space travel on human health. Short exposures to a microgravity environment can trigger changes in the body's motor control system, while prolonged space missions can cause more serious effects such as bone loss and weakened skeletal muscles.

A new space medicine programme offered by Gifu University of Medical Science and Kyoto University in Japan aims to support future manned space activities by developing specialists capable of diagnosing microgravity-induced health issues and developing countermeasures for them.

Students in the programme gain practical experience with space medicine without leaving Earth, thanks to experiments that are aimed at simulating microgravity.

"Our students learn how to conduct research on human subjects, but also have the chance to participate in microgravity experiments themselves," says Masahiro Terada, an associate professor at Kyoto University. "They can deepen their understanding of problems such as blood shift and immobility in simulated microgravity environments, and see if the coping methods presented in lectures are actually effective."

PRESSURE POINTS

Kunihiko Tanaka, a professor at Gifu University of Medical Science leads students through innovative research studying intricate connections between the vestibular systems, which are responsible for balance and spatial orientation — and the autonomic nervous system, which regulates various physiological functions including arterial pressure. These connections are apparent when a person stands up suddenly — the vestibular system detects changes in head position and increases arterial pressure to prevent lightheadedness.

The microgravity of space alters pressure gradients within the body, potentially upsetting the proper flow of blood and oxygen to tissues. To address this problem, Tanaka and his colleagues have investigated regulating arterial pressure using galvanic vestibular stimulation (GVS), a technique that involves applying a small electric current to the inner ear.

By using different strengths of GVS signals, the team can identify conditions where arterial pressure at postural change can be controlled, particularly by focusing on the otolith organs in the inner ear. "Repetitive vestibular simulation augments arterial pressure control, and the effect remains at least three days," says Tanaka. "It's basically a type of posture or motor control, and we think it should also be useful for prevent fainting in elderly people." Tanaka's current experiments simulate the effects of microgravity by getting volunteers to remain in bed for 10 days with their heads tilted downwards by 6 degrees, and they confirm the effects of GVS.

BODIES IN MOTION

Terada's research involves assessing muscle-activity patterns in the lower limbs of subjects before and after microgravity-simulating bedrest using electromyography and high-speed video. The interdisciplinary nature of his research mirrors the diverse skills needed for multifaceted challenges faced in space exploration.

"Our programmes are not just for medical students. I'd like students from a wide range of fields to learn about space medicine," says Terada. "But it's up to them how to use that knowledge, whether it's for bettering the environment on Earth, or tackling ethical issues for humans to live comfortably in space." ■

▲ **A false-coloured SEM image of sensory cells in the inner ear (left), which can detect directional movement. A galvanic vestibular stimulation device (right) applies a small electric current to the inner ear.**

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