Modulating Earth Gravitational Force for Astronauts in Microgravity Environment to Reduce Space Side Effects on Their Health

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Abstract

Prolonged zero-g (more precisely, microgravity) environment has adverse effects on astronauts' health. Bone density, muscles, heart function, blood flow, red blood cell production and the immune system are usually weakened. Astronauts now tend to do endurance types of exercise, including cycling, rowing and walking on a treadmill that stresses aerobics and stamina. But a wide consensus is developing among space physiologists and NASA officials that this approach is wrong and needs to be supplemented by strenuous workouts that increase mechanical stress on astronauts' bones and muscles. Modulating gravitational force in microgravity would exert such a force on their body similar to earth. This approach will certainly reduce space side effects on astronauts' health. Earth Gravitation Modulating- Machine (EGMM) is a proposed spinning machine which provides eccentric force in cabinets bearing treadmills which astronauts can walk or run on. The spin exerts 1 g gravitational force on the astronauts on treadmills which are perpendicular to the axis of rotation. The eccentric force enforced upon astronaut pushes him/her against treadmill. This should feel somehow like running on treadmill on earth. I propose that overall structure of EGMM would consist of 1) a shaft providing rotation, 2) cabinets containing treadmill; cabinets stand in symmetrical and balanced positions to the shaft, 3) arm; consists as a cable or a bar connecting the cabinets to the shaft; however, it is relatively long enough to provide a wide orbit to prevent dizziness. This technology can be applied to astronauts' health-care aboard the International Space Station (ISS) too. EGMM should be assembled and set to work in the exterior space of the space stations. However, based on the expressed hypothesis, the detailed engineered-designs for EGMM are to be prepared and evaluated by expert aerospace engineers.

Key words: Earth Gravitation Modulating- Machine, EGMM, Microgravity, Astronauts' health, Gravity

1. Introduction

Like every other living creature we know of, humans evolved at the bottom of gravity well. So it's not surprising that our bodies behave oddly in orbit. Adaptation to weightlessness in space involves some very complex changes in the human body, both short-term and long-term. These changes can cause health problems both in space and on return to Earth. Investigations about body reaction to long spans of weightlessness have revealed a range of health risks. Bone density, muscles, heart function, blood flow, red blood cell production and the immune system are usually weakened [1-5]. One of the worst repercussions is the continuous loss of bone mineral in space -at the rate of 1- 1.5% a month- especially from the hip and lower spine, a trend that if uncorrected over time could prevent long space voyages [6]. It appears that astronauts and future space travelers are at increased risks of suffering bone health due to microgravity, which raises serious problems for manned space exploration plans. Blood volume in the upper body is redistributed when a body floats in zero gravity. A shift of blood towards the brain could cause a painful increase in pressure within the skull. Zero gravity is also linked to inadequate oxygenation of the body, and this could be a "plausible trigger" for other side effects. These changes happen because astronauts aren't getting enough exercise [7]. In "zero-*g*", there isn't as much work, and it's all easier because astronauts don't have to lift or push things against gravity. They cannot walk on treadmills or against a hard surface. Adequate care and attention have to be given to bring about measures to ensure their consistent performance with the support of healthy body [8-12]. Evaluation of feasible new ideas by space health-researchers is necessary to overcome the health problems of astronauts. Besides, as our knowledge increases, the men and women in orbit - and hopefully beyond - should have a more comfortable time in future.

2. Hypothesis

Earth Gravitation Modulating- Machine (EGMM) to combat health threat of microgravity upon astronauts has not ever been reported. The hypothesis I propose here is that EGMM would modulate Earth's gravitational force in space stations to counteract the microgravity threat on astronauts' health. This hypothesis is based on the following points: (1) EGMM modulates Earth's gravitational force in microgravity environment in space stations; (2) it improves astronaut's bone density, muscles strength, heart function, blood flow, and other physiological functions; (3) it reduces face puff up and the "space sniffles"; (4) it makes the astronauts feel walking on treadmills somehow similar to Earth; (5) psychologically, feeling the "pull" effect of gravity is a pleasant feeling for astronauts. I propose that EGMM would consist of: 1) a shaft providing rotation, 2) cabinets containing treadmills (one/ cabinet); cabinets are positioned in symmetrical and balanced positions around the central shaft, 3) arm; consists as a cable or a bar connecting the cabinets to the shaft; however, it is relatively long enough to provide a wide orbit to prevent dizziness. This technology can be applied to astronauts' health-care aboard the International Space Station (ISS) too. EGMM should be assembled and set to work in the exterior space of the space stations. However, based on the expressed hypothesis, the detailed engineered-designs for EGMM should be prepared and evaluated by aerospace engineers.

3. Medical significance

EGMM provides the astronauts a better sustainable health and a more comfortable time in prolonged space travels. Optimized implication of EGMM would enforce the astronauts with similar to Earth's gravity. EGMM implies improved health consequences as; 1) it improves astronaut's overall performance; 2) it improves their bone density, muscles strength, heart function, blood flow, and other physiological functions; 3) it reduces face puff up and the "space sniffles"; 4) it makes the astronauts feel walking on treadmills somehow similar to Earth and 5) psychologically, feeling the gravitational "pull" is a pleasant feeling for astronauts.

4. Future testing

Considering the application of EGMM, further studies are needed to confirm its effectiveness in combating microgravity adverse health-effects on astronauts. The performance of EGMM should be verified firstly by animal experiments in orbit both in short and prolonged periods of weightlessness. When these concerns are clear, I believe that EGMM could be used as an instrument to assist improving the astronauts' health problems in weightlessness circumstances. Time and duration for using EGMM would be set by astronauts' physicians. EGMM implication should also be evaluated for rehabilitation indices after return to Earth. My ultimate goal for expressing EGMM hypothesis is to help the humans in microgravity conditions for having a better sustainable health and a more comfortable time in prolonged space travels in future ahead.

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