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Author: Ms. Adriana Pliego
Benemerita Universidad Autonoma de Puebla, Mexico, adriap3@gmail.com

Dr. Rosario Vega
Benemerita Universidad Autonoma de Puebla, Mexico, axolotl_56@yahoo.com.mx
Dr. Enrique Soto
Benemerita Universidad Autonoma de Puebla, Mexico, esoto24@gmail.com

GALVANIC VESTIBULAR STIMULATION IN FLIGHT TRAINING AND SPACE ADAPTATION

Abstract

Disorientation in Space and Space Motion Sickness are symptoms experienced by astronauts caused by the transition between gravitational environments. It is presumed that alterations in the vestibular function are involved in producing this disabling condition. Galvanic vestibular stimulation (GVS) has shown to be a potent tool to study the vestibular system on Earth. Related neural pathways such as vision, posture and autonomic function, have also been tested with this simple and portable stimulation technique, which consists on using an electrical current to modify the vestibular system's activity. Stimulation surface electrodes are placed over the mastoid process of subjects. A current of 0 – 5 mA (peak) is provided by a current generator. Current waveform and stimulation time vary between studies; both alternate and direct current have been tested. Anode and cathode placement over the mastoid process will determine the direction of movement sensation and displacement of subjects, presumably produced by the depolarization of sensory (hair cells) and neural structures of the vestibular system. GVS has been used in the aerospace sector mainly to produce movement sensation and disorientation during flight simulation while training. According to pilots who have experienced microgravity, GVS produces a very similar experience while maneuvering in a simulator. In this way, GVS is used to replicate disorientation in Space, so astronauts can improve their performance in landing, providing a more realistic experience. Another promising application of GVS is to improve postural performance. Previous clinical research has demonstrated increased stability in patients with motor disability such as Parkinson's Disease. In these studies, GVS is used in a variant known as Stochastic Vestibular Stimulation (SVS) in which stimulation waveform is white or colored noise. Improvement is thought to emerge due to stochastic resonance, a wide-spread phenomenon in nature and the nervous system, where a small amount of noise improves signal transmission. Postural control enhancement was confirmed in a study on healthy subjects who executed better on a treadmill test, with slight support surface oscillation and matching visual optic flow, while receiving SVS. For these, GVS and SVS may be considered a feasible means to prepare and assist human Space exploration. The aim of this review is to outline the use of GVS on the Space sector and envisage how GVS may contribute to lessen symptoms of Space flight and Space adaptation, based on physiological and clinical results seen in previous studies.