TACSM Abstract

A Wearable Garment to Mitigate Low Back Pain in Astronauts

CURTIS NEELD, MIRANDA MOORE, ALEXIS QUINTANA, AUDRA ROMANS, ARIANNE SCHELLER, CHARLES SWIECZKOWSKI, NICHOLAS A LEVINE and BRANDON R RIGBY

Biomechanics Laboratory; School of Health Promotion & Kinesiology; Texas Woman's University; Denton, TX

Category: Undergraduate

Advisor / Mentor: Rigby, Brandon (brigby@twu.edu)

ABSTRACT

The microgravity environment of space is known to cause a wide array of adverse physiological effects on the bodies of astronauts. Among these effects, low back pain due to space adaptation is commonly reported by astronauts. In fact, this pain, caused primarily by atrophy of the erector spinae musculature, has the highest incidence rate among all musculoskeletal-related conditions reported by this population while in space. Low back pain and the consequences of other medical conditions may become magnified as the duration of missions increases over the next few decades. Therefore, determining methods of preventing and mitigating the deleterious effects of microgravity in humans is crucial. **PURPOSE**: To design and fabricate a low-cost, diurnally worn upper-body garment with integrated neuromuscular electrical stimulation to prevent and mitigate low back pain in astronauts. **METHODS**: A custom fitted, upper-body garment that contained a neuromuscular electrical stimulation system was originally designed in three-dimensional modeling software (Solidworks Premium 2018, Waltham, MA). The garment was then fabricated using highly durable, compressive material (85% nylon, 15% lycra). This fabric allowed for maximal contact area between the skin and electrodes, which acted as the signal delivery component of the electrical stimulation system. A total of four, 4-in rubber carbon electrodes were used to ensure coverage over the motor points of the erector spinae. The electrodes were attached via wires to a controller, all of which were integrated into the garment. The garment was designed such that it would not impede an astronaut's daily activities. To determine appropriate electrode coverage and placement, a motor point identification test and motor threshold test were conducted on one human participant. Values and ranges of frequency, pulse duration, and amplitude were identified. **RESULTS**: During the motor point identification test, a circuit was created with the cathode over the motor point and the anode over the muscle belly of the erector spinae to determine specific electrode placement. With a constant frequency of 20 Hz, the ideal ranges of pulse duration and amplitude were identified to be 50-300 μs and 30-80 mA, respectively. These parameters would ensure that the simulation was sufficient to activate the motor threshold (i.e., above the sensory threshold but below the noxious threshold). **CONCLUSION**: The implementation of a neuromuscular electrical system could mitigate and prevent disuse atrophy of the erector spinae muscles while in space. By integrating this system into a diurnally worn upper-body garment, space-induced low back pain may be treated in astronauts.