**Scholar: Pilot and Validation Studies** ISSN: 2689-7644
Volume 3 Issue 1 Pages: 10 – 13 DOI:10.32778/SPVS.71366.2022.26

# OMM in Space: Considerations for osteopathic manipulative medicine in space applications

Authors: Matthew Knapp, OMS III[1] and Stephany Esper, DO[1]

Affiliations:
1. Lake Erie College of Osteopathic Medicine: Erie, PA

Keywords: Osteopathic manipulative medicine, OMM, OMT, space medicine, space flight, space



**Abstract:**

**Introduction:**

Osteopathic manipulative medicine (OMM) is the therapeutic approach to medicine involving hands-on treatment to alleviate the structural or functional dysfunctions which may be present in the human body at any given time, especially after physically taxing activities. OMM has proven successful in the treatment of these dysfunctions on patients for over a century on earth. Little is known about how OMM could be applied in a zero-gravity environment such as space. This paper will explore how OMM may be implemented into the care of astronauts both on the ground and during long duration spaceflight.

**Methods and Results:**

A PubMed search for "Osteopathic Manipulative Medicine" and "Space Flight" yielded zero results.

**Conclusion:**

Somatic dysfunctions from microgravity environments are known to occur. We postulate that there are special treatment considerations for addressing somatic dysfunctions developed in microgravity environments that are different from those developed on earth. More research is needed to determine which techniques are the most effective and safest for space travel. The research will need to also determine any changes in techniques along with the timing of them, to make them most suitable for use in space medicine.

**Article History:** Date received: 12/10/2021 Date revised: 03/10/2022 Date accepted: 04/05/2022
**Corresponding Author:** Mathew Knapp **E-mail:** mknapp87x@gmail.com

## Introduction:

Osteopathic manipulative medicine (OMM) is the therapeutic approach to medicine involving hands-on treatment to alleviate the structural or functional dysfunctions which may be present in the human body at any given time, especially after physically taxing activities. OMM has proven successful in the treatment of these dysfunctions on patients for over a century on earth. Little is known about how OMM could be applied in a zero-gravity environment such as space. This paper will explore how OMM may be implemented into the care of astronauts both on the ground and during long duration spaceflight.

## Methods and Results:

A PubMed search for "Osteopathic Manipulative Medicine" and "Space Flight" found zero results.

## Discussion:

In the early days of spaceflight, Russian cosmonauts had reported hyperreflexia upon returning to the 1-G environment of Earth. This finding was reproduced by the crew members of the Skylab 3 mission in 1973. It was hypothesized that this hyperreflexia was due to muscle imbalance resulting from atrophy of the muscles in zero gravity environments for prolonged periods of time.[1] Fast forward 50 years and it is widely recognized that muscle atrophy is a feature of long duration space flight and has posed an area of extensive research.

Even with exercise regularly, astronauts still lose muscle tone. Physiologists have discovered the reason being that muscle atrophy is the body's natural response to decreased load in microgravity, making it difficult for astronauts to artificially counteract this natural phenomenon. Even so, muscle atrophy often leads to a somatic dysfunction. A somatic dysfunction is any alteration in the components of the somatic system, including skeletal, arthrodial, and myofascial structures and their related vascular,

ISSN: 2689-7644
DOI:10.32778/SPVS.71366.2022.26

lymphatic, and neural components. Osteopathic manipulative medicine (OMM) diagnoses and treats somatic dysfunction.

Back on Earth, many of the OMM techniques taught in the lab are aimed to relieve the effects of a muscle imbalance. When a muscle imbalance occurs due to atrophy, sudden movement, or trauma, then spinal facilitation and increased muscle spindle sensitivity follow. The result is a restricted range of motion. In addition, a muscle imbalance directly involves the pulling of affected muscles on their bony attachments.

For example, forces generated on the vertebrae in the thoracic or lumbar spine by tight, spastic long restrictors, such as the erector spinae and quadratus lumborum muscles cause a dysfunction following Fryette Type 1 mechanics. This is where the spine is in neutral and a series of vertebrae have sidebent one direction and rotated the opposite. The same application of forces, except by tight, spastic short restrictors, such as the multifidus muscles cause dysfunction following Fryette Type 2 mechanics, where a single vertebra is in an extreme position (flexion or extension), sidebent one direction, and rotated the same. Although the cervical spine does not follow Fryette mechanics, muscle spasms still cause vertebral sidebending and rotations. Furthermore, forces acting upon the ribs cause inhalation or exhalation dysfunctions, whereas forces acting upon the pelvic area result in innominate shears or sacral rotations. After a somatic dysfunction has been diagnosed, the osteopathic physician can use OMM techniques such as: muscle energy or high-velocity-low-amplitude (HVLA) to reposition the dysfunctional segment (Table 1).

**Table 1: Summary of Indications for OMM**

| Proposed Indication | Aim of Treatment |
|---|---|
| Research tool | Monitor treatment<br>Identify repeated areas of stress |
| Muscle atrophy | Retrain muscle strength and proprioception |
| Enhance circulation | Counteract microgravitational effect on lymphatic and cardiovascular systems<br>Promote immunity |
| Adjunct to medication during long duration flight | Have potential treatments at hand when access to medication is sparse |

Those who engage in space flight use their bodies in ways the average person does not often encounter. Whether that be fighting the strain of multiple G-forces in rocket ascent or navigating the tight environment of the International Space Station for lengthy periods of time. These unusual movements combined with muscle atrophy itself are recipes for somatic dysfunctions.

An osteopathic exam upon return to Earth serves two purposes. One, it can be used as a research tool. A trained osteopathic physician can very easily identify somatic dysfunction, and this will give researchers one more method of examining the effects of space flight on the musculoskeletal system. Two, OMM is a necessity for quality, whole body care of any patient, and astronauts particularly will benefit from the evaluation and treatment of muscle dysfunction, or any other imbalance after their trip in space where conditions are not so pleasant.

In addition, osteopathic exams and treatment during long duration space flight have the potential to maintain musculoskeletal integrity by proactively countering the skeletal effects of muscle atrophy. Astronauts must land on Mars healthy and prepared to engage in arduous work.

However, OMM is not without limitations. Skeletal fragility as a result of calcium loss from the bone is a feature of microgravity.[2] This may pose a risk with some OMM treatments (Table 2).

**Table 2: Summary of possible relative contraindications for OMM**

| Proposed Contraindication | Comment |
|---|---|
| Practicality in microgravity environment | Osteopathic techniques which do not rely as heavily on exertion of force may need to be utilized |
| HVLA upon return to gravity | Skeletal weakness |

Furthermore, in space, without the loading forces of gravity, astronauts can grow (expand) up to 7 centimeters.[3] This growth separates the space between two vertebrae, increasing the likelihood of a herniation. Such is the reasoning why astronauts are carefully carried out of the spacecraft upon landing back on Earth and are urged not to do strenuous activity for quite some time thereafter. More intense techniques, such as HVLA could pose risks on the weakened spine. With this said, OMM has been demonstrated to alleviate pain associated with disc

ISSN: 2689-7644
DOI:10.32778/SPVS.71366.2022.26

herniation.[4] Thus, the aforementioned should not preclude osteopathic treatment, but could rather serve as a relative contraindication for certain forceful treatments, such as HVLA.

In addition, it should be considered whether OMM techniques, the majority of which rely on gravity and/or the exertion of forces are practical in a zero-gravity environment. This is an area future research should be able to address.

Nonetheless, OMM boasts a large toolbox and is not limited to the treatment of a muscle imbalance. The human cardiovascular and lymphatic systems evolved under Earth's gravitational forces. As a result, when in space, astronauts experience a mild form of fluid buildup in the head due to the zero-gravity environment, known rather comically as the "puffy head bird legs" condition. OMM lymphatic treatment will expedite the recovery of edema. After first treating the thoracic inlet, the Miller thoracic pump can be utilized, as it is designed to drain lymphatic fluid from above the level of the neck.

Furthermore, due to the structure of the lymphatic system, adequate lymphatic circulation is necessary to promote immune responses. Astronauts are faced with a unique microbiology environment. Although attempts are made to sterilize the space craft, microorganisms have and always will evolve. Extreme conditions effectively select for the resistant microorganisms to such a degree that there has been a new species of bacteria discovered on board the International Space Station.[5] Bacteria find ways to accumulate in things such as the air circulation in space craft as well. Surrounded by unique bugs, it is critical for the astronaut to maintain a fully functional immune system. In addition, small amounts of debris float in the space craft, contributing to upper respiratory infection.[6] There is a plethora of OMM lymphatic techniques, from techniques designed to promote lymphatic flow such as pectoral traction and the previously mentioned Miller thoracic pump; to techniques designed to remove lymphatic restrictions, such as thoracic inlet myofascial release treatment, re-doming the diaphragm, and rib raising (Table 1). Rib raising improves lymphatic flow via restoring proper rib movement. This technique has been demonstrated to alleviate sympathetic nervous system tone.[7] An overactive sympathetic nervous system may be present in an astronaut who is faced with stressful situations throughout their mission in space, and rib raising is a quick and simple treatment that has the potential to minimize the undesirable physiologic effects of this prolonged sympathetic stimulation. The ability to perform OMM treatments may be imperative when access to medications during space flight is sparse.

**Conclusion:**

Somatic dysfunctions from microgravity environments are known to occur. Our literature search found a literal absence of osteopathic research with respect to space medicine. We postulate that there are special treatment considerations for addressing somatic dysfunctions developed in microgravity environments that are different from those developed on earth. Osteopathic manipulative medicine has the potential to aid in the treatment of medical problems encountered from space travel. More research is needed to determine which techniques are the most effective and safest for space travel. The research will need to also determine any changes in techniques along with the timing of them, to make them most suitable for use in space medicine.

**Author Contributions:**
Provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data.

**Funding Sources:** None.

**Potential Conflicts of Interest Disclosures:**
The authors disclose that there were no conflicts of interest or financial support in the development of this project. All data is authentic and accurate.

**References:**

1) Baker, J. T., et. al. (1976). Chapter 15: Changes in the Achilles Tendon Reflexes Following Skylab Missions. In Biomedical Results from Skylab.
2) Elliot, Ross. "NASA's Chief Medical Officer Discusses the Astronomic Rise of Osteopathy." Future of Personal Health, 24 February 2021, https://www.futureofpersonalhealth.com/osteopathic-medicine/nasas-chief-medical-officer-discusses-the-astronomic-rise-of-osteopathy/.
3) Space Medicine [Podcast series episode]. (2015, December 16). In Space. BBC World Service.

ISSN: 2689-7644
DOI:10.32778/SPVS.71366.2022.26

4) Burton, A., Tillotson, K. & Cleary, J. Single-blind randomised controlled trial of chemonucleolysis and manipulation in the treatment of symptomatic lumbar disc herniation. E Spine J 9, 202–207 (2000). https://doi.org/10.1007/s005869900113
5) Mason, Christopher. "Could Humans Have Contaminated Mars with Life?" BBC Future, BBC, 10 May 2021, www.bbc.com/future/article/20210510-could-the-perseverance-rover-have-carried-life-to-mars
6) "An osteopathic physician helps ensure astronauts stay healthy in space." Doctors of Osteopathic Medicine, https://findado.osteopathic.org/an-osteopathic-physician-helps-ensure-astronauts-stay-healthy-in-space.
7) Henderson AT, Fisher JF, Blair J, Shea C, Li TS, Bridges KG. Effects of rib raising on the autonomic nervous system: a pilot study using noninvasive biomarkers. J Am Osteopath Assoc. 2010 Jun;110(6):324-30. PMID: 20606239.