Review Article

International Journal of Dental and Health Sciences
Volume 01,Issue 06

# WEIGHTLESSNESS & TEMPOROMANDIBULAR JOINT: A REVIEW

**Ankita Bohra[1],Usha Bohra[2],Ramakant Bohra[3]**

1.Post Graduate, Oral medicine & Radiology,Vyas Dental College & Hospital,Jodhpur, Rajasthan
2.J.S. Gynae.Jodhpur, Rajasthan
3.Senior medical Officer,Govt. Hospital C.H.B, Jodhpur

## ABSTRACT:

Weightlessness is defined by absence of gravitational force that is exerted on living & non living things from the core of earth. We are habitual of earth's atmosphere & our body is acclimatized according to it. Right from birth to death we remain with in the gravitational zone of earth & it suites us best than anything else. In case of space explorations, astronauts feel zero- G or microgravity of which we are not habitual of. Though space exploration for astronauts has became a very challenging as well as an important task yet these missions are very injurious from their health point of view. Astronauts experience a lot of uncommon things & an unfamiliar environmental condition in outer space which we are not used to of. They experience an innumerable injurious health effects which we don't experience just because we have our gravitational protection force which works as a shielding. Weightlessness affects adversely almost every system of human body whether it is cardiovascular, cranial, respiratory, reproductive, excretory & skeletal system. This review principally focuses on less discussed topic of the effect of weightlessness on temporomandibular joint (TMJ).

Keywords: Astronauts, TMJ, Weightlessness

## INTRODUCTION:

'Konstantin Tsiolkovsky', stated that, 'The earth is a cradle for mankind but one cannot remain in a cradle forever'. Space exploration is the best example that fits this quote. As being a Human, it is our wish from many years to discover something new & to do best possible to get that.[1] Biggest fact is that everybody knows a trip to universe is equally fascinating, curious & dangerous as well from each & every point of view. Looking towards the dangerous side, we all thinks that flying in sky is a very adventurous experience we all somewhere wish to do that but, it is not as good as it looks. Experiencing weightlessness or zero-G is not an easy task.[2-3] Astronauts undergo many training sessions underwater because in water gravitational force exerted on human body reduces & thus an astronaut feel slight effect of weightlessness but not as like as of space.

On a space mission some of the perils are obvious like hard vacuum, unpredictable radiations & extreme cold but along with these some least observed entity is effect of long term weightlessness on human body.[4] Though its effect is slow & subtle, yet it is harmful if proper precautions are not followed by the cosmonauts. Very few

*Corresponding Author Address: Dr Ankita Bohra, Post Graduate, Oral medicine & Radiology,Vyas Dental College & Hospital,Jodhpur, Rajasthan. Email id: aav1423@hotmail.com.

studies are published so far on the effect of microgravity & changes in temporomandibular joint form & function.[5]

**Effect of weightlessness on body:** Weightlessness affects human body in almost every way whether it is physiologic or psychologic. These effects includes bone loss by loss of bone mineral density, loss of muscle mass, reduction in number of red blood cell count, fluid imbalance, changes in immunity level, cardiovascular & sensory motor de-conditioning, reduced cardiac muscle mass resulting in diminished cardiac function, circadian related problems involving sleep & performance, increased flatulence. [6,7]

**Effect of weightlessness on bones & supporting structures:** Need of gravity for maintain homeostasis is felt during space trip. For human beings, skeletal system is the backbone of our posture, our strength to stand & perform multiple functions like walking, running, dancing etc. Bones play a major role in all these activities. Bones are dynamic living tissues which undergo repeated resorption & deposition under the effect of mechanical stress & strain. In absence of gravity, less mechanical strain is applied to bones & joints thus resulting in bone loss.[8] Due to bone loss, bone mineral density decreases which result into weak bones & more prone to fractures. All processes starting from bone formation, new bone deposition to bone mineralization decreases or stops during the phase of weightlessness.[9] Skeletal muscle support is also not required for maintaining posture thus resulting in weakening of these muscles.[10] Imbalance in fluid distribution of body result into 'moon face' appearance of face.

During microgravity phase, due to reduced stress on bones, they tend to loose minerals & become porous. Few studies have noted the effect of microgravity on osteoclastic activity which leads to bone resorption.[11-13] Other studies suggest that during weightlessness level of hormone like glucose-dependent insulinotropic peptide increases after meal. This hormone is favorable for osteoblastic activity of bone & induces bone deposition.[14,15] Still a topic of debate & further research

**Effect of microgravity on Temporomandibular joint:** Temporomandibular joint is the most complex joint of our body. It provides hinging movement in one plane ( a ginglymoid joint) & at the same time it provides sliding motion( arthroidal joint) & hence it is termed as ginglymo-arthroidal joint[16]. It is made up of temporal bone, mandibular condyle & an articular disc, which acts as a bony connection hence classified under the category of compound joint. It is surrounded by strong facial musculature, ligaments & tendons, which allows its movement.[17]

In microgravity state, along with physiological changes, psychological stress also increases like sleep disturbances, disfigurement of circadian rhythm of body. In stressful condition, body activates hypothalamic activity, which in turn prepares body to response.[18] There occurs activation of the autonomic nervous system. Hypothalamus increases the

activity of gamma efferent which causes intrafusal fibers of muscle spindle to contract, giving an overall effect of increase in muscle tonicity.[19]

In case of microgravity there is reduction in overall muscle mass thus causing insufficient increase in muscle tonicity during stressful period. The effect of stress directly affects the temporomandibular architecture along with over all reduction in bone mineral density of complete body.[20] Abnormal facial expression, loss of sensation of pain and temperature, decreased tongue, and mandibular movements in simulation microgravity environment were observed due to fluid shift mechanism. Thus the effect on TMJ experienced by cosmonauts is more psychological than physiological.[21] In longer duration space visits, circulating parathormone concentration also reduces which in turn reduces vitamin D metabolism & thus resulting into overall vitamin D deficiency. The effect on disorientation of complete body homeostasis affects combinedly towards disarrangement of temporomandibular joint function. Problem increases with longer missions & frequent visits.[22]

**Countermeasures:** Countermeasures include exercises, proper intake of calcium & vitamin D supplements, nutrition diet & proper hydration of body. All such measures do not completely compensate the metabolic loss during space flight.[23] It is still a matter of further study.

## CONCLUSION:

Spaceflight-induced bone loss poses significant health risks for cosmonauts from past few decades & still a question that is unsolved. Being oral diagnosticians, oral & maxillofacial perspective of microgravity is also a less understood topic. Future research is required to better understand the nature of this destruction and to develop means to counteract it. Successful resolution of these tasks will increase crew safety during spaceflight, will enable human exploration missions.

## REFERENCES:


1. Baldwin KM, White TP, Arnaud SB, Edgerton VR. Musculoskeletal adaptations to weightlessness and development of effective countermeasures. Med Sci Sports Exerc 1996;28;10:1247-1253.
2. White RJ, Averner M. Humans in space. Nature 2001;409;6823:1115-1118.
3. Rai B, Kaur J. Association between Stress, Sleep Quality and Temporomandibular Joint Dysfunction: Simulated Mars Mission. Oman Medical Journal .2013; 28; 3:216-219.
4. Korszun A, Young EA, Singer K, Carlson NE, Brown MB, Crofford L. Basal circadian cortisol secretion in women with temporomandibular disorders. J Dent Res 2002 ;81 ;4:279-283.
5. Mongini F, Ciccone G, Ibertis F, Negro C. Personality characteristics and accompanying symptoms in temporomandibular joint dysfunction, headache, and facial pain. J Orofac Pain 2000; 14; 1:52-58.
6. Heer M, Kamps N, Biener C, Korr C, et al. Calcium metabolism in

microgravity. Eur J Med Res 1999;4:357.

7. Whedon GD, Lutwak L, Rambaut P, et al. Effect of weightlessness on mineral metabolism; metabolic studies on Skylab orbital flights. CalcifTiss Res 1976;21 :423.
8. Whedon GD. Disuse osteoporosis: physiological aspects. CalcifTiss Int 1984;36:S146.
9. Rambaut PC, Goode AW. Skeletal changes during space flight. Lancet 1985 ;2(8463): 1050.
10. Oganov VS, Rakhmanov AS, Novikov VB, et al. The state of human bone tissue during space fligl;tt. Acta Astronautica 1991;23:129-132.
11. LeBlanc A, Schneider V, Shackelford L, et al. Bone mineral and lean tissue loss after long duration space flight. J Musculoskeletal Neuron Interact 2000; 1: 157-164.
12. LeBlanc AD, Schneider VS, Evans HJ, Engelbretson DA, Krebs JM. Bone mineral loss and recovery after 17 weeks of bed rest. J Bone Miner Res 1990;5:843.
13. Zittennan A, Heer M, Caillot-Augusso A, et aL Microgravity inhibits intestinal calcium absorption as shown by a stable strontium test. Eur J Clin Invest 2000;30: 1036.
14. Smith SM, Davis-Street JE, Fontenot TB, Lane HW. Assessment of a portable clinical blood analyzer during space flight. Clin Chern 1997;43:1056.
15. Leach CS, Rambaut PC. Amino aciduria in weightlessness. Acta Astronautica 1979;6:1323 .
16. X. Alomar, J. Medrano. Anatomy of temporomandibular joint. Semin Ultrasound CT MRI 28:170-183
17. Smith SM, Nillen JL, LeBlanc A, et al. Collagen crosslink excretion during space flight and bed rest. J Clin Endo Metab 1998;83:3584.
18. Vermeer C, Wolf J, Knapen MH. Microgravity-induced changes of bone markers: effects of vitamin K-supplementation. Bone 1997;20;4:16-20.
19. Carlson CR, Okeson JP, Falace DA, Nitz AJ, Curran SL et al: Comparison of psychologic and physiologic functioning between patients with masticatory muscle pain and matched controls, J Orofac Pain 7:15-22, 1993.
20. Zhang ZK, Ma XC, Gao S, Gu ZY, Fu KY: Studies on contributing factors in temporomandibular disorders, Chin J Dent Res 2:7-20, 1999.
21. Nordin BEC, Need AG, Morris HA, Horowitz M. The nature and significance of the relationship between urinary sodium and urinary calcium in women J Nutr 1993; 123;16.
22. Heer M, Zitterman A, Hoetzel D. Role of nutrition during long-term spaceflight. Acta Astronaut 1995; 35: 297.
23. LeBlanc AD, Schneider VS. Countermeasures against space flight related bone loss. Acta Astronaut 1992; 27: 89.