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Mini Review

Physiotherapy in Space - Microgravity Motion!

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The environment in the space that is international space station is not exactly so friendly to human body system. Thanks to micro gravity or no gravity astronaut experience a lot of health, physical and physiological changes while living there in space some of which they can avoid through daily activities and exercises, but the environment there in space also exposed astronaut to other element that cannot necessarily be mitigate it so our bodies is not built for space as microgravity [1]. Our body is built for earth which has gravity environment, so in low orbit, these elements are taken when body will system accordingly so our bodies are'nt built for space. As I always say physiotherapy is limitless and it expended wings to horizons beyond earth also that is in space and this one example when we are exposed to micro gravity, the humans like astronaut which experience physiological changes going inside their body similar to like the patient who is in ICU like bedridden patient or or athlete well who is under the training so therapist works with few sports scientist and help them to prepare a condition for astronaut for space in flight pre-flight and post flight condition so when they are going before and during the flight and when they return, we prepare the body physiological condition for the experience so as I say, the role here start with to add stress relief, counteracting the symptoms of preflight and flight and curate exercise during their stay [2]. Astronauts are susceptible to a variety of health risks including decompression sickness, barotrauma, immunodeficiencies, loss of bone and muscle, loss of eyesight, orthostatic intolerance, sleep disturbances, and radiation injury.

"Physiotherapy is Limitless! "

- **Short Space Flight:** A flight of one to fourteen days is considered Short flight [2].
- **Long Space Flight:** More than two weeks is considered a long flight [2].

Why Physiotherapy?

So let's talk about physiotherapy in the space so we can say it's more about most motion only so why we have to take physiotherapy there because you know when we talk about the space so health priorities are important because for exercise to exercise while they are in space as a exercise is the number one priority. we need a proper cardiovascular physiological and respiratory system to for proper health of a person of astronaut so to stay fit in space the astronauts are need to exercise for at least one and a half to two hours per day for six days per week according to principal so however, they can go for seven days exercise also but they perform both cardio and weight training or resistance training to keep their muscles and bones strong. Data on weight training and aerobic exercises would definitely help astronaut to stay fit and healthy while on the space station [3].

Let's talk about changes in human body with space traveling?

So have you ever imagined when you're going out of earth or orbital into the space affect a human body system? It's complete physiology biology. It's medical condition. It's chemical compound condition. Everything is that sick. Like if you talk about an example Like who if you talk about like kind of if you're going to any planet will take that millions of kilometers away from our earth so

now you can imagine how much our body is going to change or happen is is going to happen during that year trip and it was with the issues in the these are the issues in National Aeronautics and Space Administration building features in an astronaut who will be stationed at international space station, which is around 400 km so complete orbit around earth every day [4].

What adaptations/changes were found?

Physiological changes

Physiological changes are bicycle changes so what are the changes that are going to be there in the human body when you talk about a person astronaut is going to space it's going to live there so before understanding, there are two type of flight that is short flight is less than 14 days and a long flight is more than 14 days as per astronaut timings and sort of space. They are sharing their so their conditions which is going to be changed the sort of changes is physiological adaptation cardio best system adaptation your body feuded as adaptation pulmonary adaptation neurosensory adaptation, and the muscular skeleton adaptation so when we talk about the physiological adaptation, it depends upon the duration of the flight as I already told it's less than 14 days or more than 14 days so it will work on your reduced hydrostatic gradient and reduce ground reaction force because you're not touching the field beyond the gravity and there's no gravity at all so when we talk about key. These adaptation occurred due to these micro gravity and reduce hydrostatic gradient or reduced ground reaction, force, resulting in unloading, enhance use of weight bearing structures during the space stay of the astronaut so we have to prepare them for the physiological adaptation [1, 5]

Cardiovascular changes

In Cardiovascular system adaptation due to a micro gravity means no gravity at all there is reduction of hydrostatic gradient that will lead to this upward shift of blood and flutes in Torrice reason and also shift of flute from extracellular space to intracellular space means you can whenever we see a storage space then they came from the space station. They have that puffy face because of that the total cardio work reduces now you can understand so when the astronaut is continuously for so many days exposed to micro gravity is no gravity at all the volume of left ventricle reduces so there is evidence of car atrophy on magnetic resonance, imagining result from prolong exposure to no gravity, micro gravity, no gravity it has been found in data and analysis that while returning to earth to gravity reduction in orthostatic tension, which result in posture, hypotension, while returning to the earth [6].

Pulmonary changes

Pulmonary adaptation, pulmonary diffusing capacity for carbon monoxide increase in setting and standing position during starting week that is third day in micro gravity, then return to pre-baseline values. This result is reduced maximum exile capacity means exposure to micro gravity lead to astronaut to reduced maximum exercise capacity and start showing after three day of preflight level [7].

Body fluid changes

Body food adaptation does decrease mass of plasma volume and red cell mass during both. It's a lesson 14 or more than 14 that is short or as well long space flight your hemoglobin actually level is always constant that is slightly increased or unchanged after short space flight while it decreases after long space flight, the red cell morphology does not change after short space light, but as a rapid reversal of in flight change in red blood cells of which occurred due to increased potassium intake during long space, light and astronaut weight changes can vary from gain of 0.1 KG to loss of 5.9 KG your fruit loss account for 50% of weight loss and rest is due to fats and proteins in advocate energy intake led to your fat loss because the less amount of carbohydrate they're taking [7].

Neureurovascular changes

Neurovascular or neurosensory system approach 40 to 70% of astronaut during in flight. Your exhibit neuroblast effect which include immediate reflects motor response that is postural illusion your sensation kind of tumbling or rotation dizziness to vertigo and space motion, sickness, like pallor, cold sweat, nausea, and vomiting. The most motion sickness can also appear in flight, but it may subside after 2 to 7 days the most common symptom post light are your clumsiness difficulty in walking in an aligned line while walking, feeling vertigo while standing also feeling vertigo, nausea kind of feeling difficulty while concentrating and feeling of vomiting in 60% of astronauts Neuro deficit persist after landing due to morphological changes in athletes organ when in flight these disturbance are same in short and long space flight however post flight difficulties, smelling attaining partial equilibrium and other vegetable disturbances are more pronouncing long space flight. So we can say in 70% astronaut during and fly in flight condition the

astronaut experience your post illusion rotation dizziness party goes special motion, sickness, which include cold, sweating, nausea, and vomiting and pallor so the symptoms of morning sickness also occur, which will subside after 2 to 7 days, even though the symptom can endanger the overall health of that person that is astronaut so when we talk about post flight neurological symptom include your particles, outstanding sitting and walking from tennis and difficulty of walking on straight line or maintaining postal equilibrium, these changes are common in both long and short flights [8].

Musculoskeletal changes

Musculoskeletal adaptation in that like if a astronaut is living in a micro gravity when exposed to micro gravity will have a more flex position ascent of gravity center of mass shift from L3 vertebra that is line of gravity, which is passing is shift more so he will feel more flex posture and exposure to micro gravity will also lead to reduce ground reaction, force, resulting in reducing loaded loading and use of weight wearing structure, so there is result in muscle atrophy and bones demineralization so muscle atrophy may cause muscle strength alteration affecting the muscle activities [9].

Cardiovascular	Musculoskeletal	Neurosensory	Body fluids	Pulmonary	Physiological
Decreased blood volume	Muscle atrophy	morphological changes in otholithic organs	Red cell morphology doesn't change with short flight while decrease with long.	Carbon monoxide increasing in sitting and standing position	Microgravity [9]
Decreased diastolic blood pressure	Decreased force and strength of muscle contraction	Peripheral proprioceptive deficits	Decrease plasma volume	Pulmonary diffusing capacity for CO	Reduced hydrostatic gradient
Electrolyte changes	Decreased bone density	Impaired integration of central and peripheral signals from various organs	Decrease red cell mass and Haemoglobin remains unchanged with short and increase with long flight.		Reduced ground reaction force [9]
Lead to: dizziness, loss of consciousness	Lead to: muscle fatigue, stiffness, osteoporosis, renal stone formation	Lead to: ataxia, mototr planning problem, clumsiness, paroxysmal disturbances	Lead to : Astronaut weight change can vary from a gain of 0.1 kg to loss of 5.9 kg.	Lead to: Reduced maximal exercise capacity	Lead to: Unloading anbd disuse of weight bearing structures during the space stay. [9]

Table a

Astronaut Training Protocol will be llike

- Pre flight training
- In-flight training
- Post flight training
- Bact to ADL

So physiotherapy in space basically is made from your four stages that is preflight training in flight training, post flight training and back to function your normal activities so pre-flight training means when you're preparing for your space stay and in flight when you are into the space station and post flight when you just came back from the space and just with all the changes adaptation in your body system, how you have to adapt to the and back to the function so in preflight condition, our goal is basically as physiotherapist is to familiarize the astronaut for in flight situation. Keyboard is going to happen and treat any pre-existing musculoskeletal and neurological disorder if there is any persistent condition [10,11].

Pre flight training

In preflight training, we just feis the astronaut with in-flight training program treat any pre-existing neuromuscular or muscular skeletal condition. Prepare the astronaut for space and conduct preflight measures so initial assessment will include your posture your motor control and functional movement as well as you we have to check our joint and pre-existing condition if there is any an your physiotherapy modalities will be there and we have the we can go for manual therapy, motor control training and elements from proper subjective neuromuscular facilitation that is PNF and facial 320 if it is required and home program is given to astronaut and will be checked and assist and progressed and the basic goal is to optimize postural control by performing exercise on advanced resistive exercise revise that is ARED [12].

Advanced resistive exercise device that is a AERD is a form of strengthening device in international space station ISS that is can be used on for strength training and focus is basically on posture, pelvic tilt and spine by performing resistant exercise, aerobic conditioning and adaptation should be done in free fight stage only goal level micro gravity stimulation can be done by five basic strategy head down position with head tilt for 3 to 12° water inversion where the astronaut is supine lies is supine in a water tank for about 24 hours and perform complex eye hand coordination task mimicking skills required for space, light mobilization in bed, confident and short per flight for brief period of weightlessness [13,14].

In flight training

In flight, strange or in flight training will include the astronaut is required to perform two hours of training effective in flight. Workouts include treadmill cycle ergometer low rowing, areometer dynamic resistant exercise for upper and lower body have always proven to effect in maintaining joint range of motion and muscle strength advanced economic resistant device to free weight exercise, using piston, vacuum cylinder along with flywheel system to exercise all the major muscle group. These exercises include squares, dead lift, car, phrase, etc. in addition to this space cycle can be used so we are using basically your bicycle, lowering machine, dynamic resistant and ARED so to optimize a positive effect of load on bones and muscle, and minimize stress on joint and passive structure for safety, which is the Arabic works to ensure that the astronaut spinal legs are in optimal alignment to optimize performance and safety RED exercise are monitored using real time, feedback via an audio and video conference link with the physiotherapist and sports scientist [15].

Post flight training

Post flight the conditioning or stage in post flight conditioning is implemented within 24 hours after the astronaut is written for art of landing so the main goal or aim of physiotherapist here is preventing short, a long-term painful condition such as lower back pain, addressing any mission infuse physical health problem, return to preflight physical fitness level so we have to re-adapt and re-resume of loading in astronaut prevent the long-term effect of spaceflight on neuromuscular skeletal system so basically the reconditioning program having the principal include recover posture, control, muscle control, and balance normalization of muscle recruitment using strategies of motor control pretraining the postal control with alignment with the line of gravity. Once the post is corrected implement strength training, miss first when the astronaut coming we have to work on the posture, muscle control, and balance, then normalize the muscle recruitment then retraining, a posture control then once posture is obtained, we have to work on strength training so the timeline for the conditioning program involve the astronaut being seen daily for two hours for up to three weeks with a break over second weekend if further care for physiotherapist is required requested program can be extended so motor control training and positive training are the key objective when we talk about the post flight reconditioning and if however, the restaurant is unable to control the spine alignment during function, then encourage to exercise at a lower level to have the quality of movement by loading on loading so return 1+2 days initial examination assessment are done with retraining, posture written 343+4 days progress progression can be made in motor control and partial exercise exercises and return for – five days it is from here exercise are curated along with the sports scientist. Equity exercise are very helpful and also pedals of movements are improved on a standard treadmill so bicycle, kilometer balance and coordination or assist in this face motor control strategies can be progressed here [16,17].

Exercise equipment in Space station!

- Cycle Ergometer
- Treadmill

- Resisted exercise device
- AERD
- Cycle with vibration and stabilization system

Equipment the Internation space Station is using is basically there's three equipments that is first cycle Argo meter like a bicycle. We are having in our clinics or in our therapist walk main activity. There is paddling. It is used to as a fitness in space because it's easy to check heart rate and how much fuck is being done second treadmill, walking or jogging on treadmill like walking on earth walking is a single most important way to keep bones and muscle healthy because the lack of gravity tend to make people float harness are attached to the astronaut to hold them to the walking surface so resistant exercise device look like your weightlifting machines. You may see on televisions astronaut pull and stretch rubber band like cord to pulley so your rat can be used for total body workout that ARED advanced resistant exercise device is basically designed for weightlifting in weightless [18]. Environment consist of two calculated pistol driving system with a flywheel mechanism so astronaut can use this machine to perform exercise like dead lift squared biceps curl and carries the fifth one we have cycle, Algo meter with vibration, isolation and stabilization system that is service. It is like a stationary bike in space does not have a seat because of zero gravity or Michael gravity astronaut can snap their shoes in the paddle and go for a with a seatbelt to cycle upright they can adjust workload and change the speed to hit their target heart rate so now we know space radiation is going to concern for those traveling into deepest space NASA studies the effect of space radiation at a special level at Brookhaven national laboratory and other scientist using particular acceleration to create stimulated space agency how it's affect by logical samples instead of bringing the samples up to radiation. We bring the radiation down to sample. He says it's research that is helping space station create better shielding that can mitigate dictation space potentially showing as to travel deeper into space than ever before [19,20].

Conclusion

With upgrading technologies in physiotherapy there is effective exercise protocol like optimal exercise training are required to minimize harmful deconditioning on astronaut physiological, neurological, performance and overall health due to zero gravity. So exercise by physiotherapist is essential for rehabilitation of astronauts. It can be used as powerful stress management with many other health benefits.

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