Biomechanical Analysis of T2 Exercise

NASA-Johnson Space Center

Exercise Physiology and Countermeasures Project/SK

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Background

- Crewmembers regularly perform treadmill exercise on the ISS
- With the implementation of T2 on ISS, there is now the capacity to obtain ground reaction force (GRF) data
- GRF data combined with video motion data allows biomechanical analyses to occur that generate joint torque estimates from exercise conditions
- Knowledge of how speed and load influence joint torque will provide quantitative information on which exercise prescriptions can be based.

Objectives

Determine the joint kinematics, ground reaction forces, and joint kinetics associated with treadmill exercise on the ISS.

This study will:

1) Determine if specific exercise speed and harness load combinations are superior to others in exercise benefit.

2) Aid in the design of exercise prescriptions that will be most beneficial in maintaining crewmember health.

Experiment Design

Preflight	In-Flight	Postflight
1 training & test session* Any time prior to flight: 1.25 hours (Experiment Briefing/Training + Test Session)	Approx FD 30 and every 30 days thereafter during mission** **Up to 6 in-flight sessions	NONE *If preflight data collection not possible, BDC could occur after landing

Session Description - Preflight

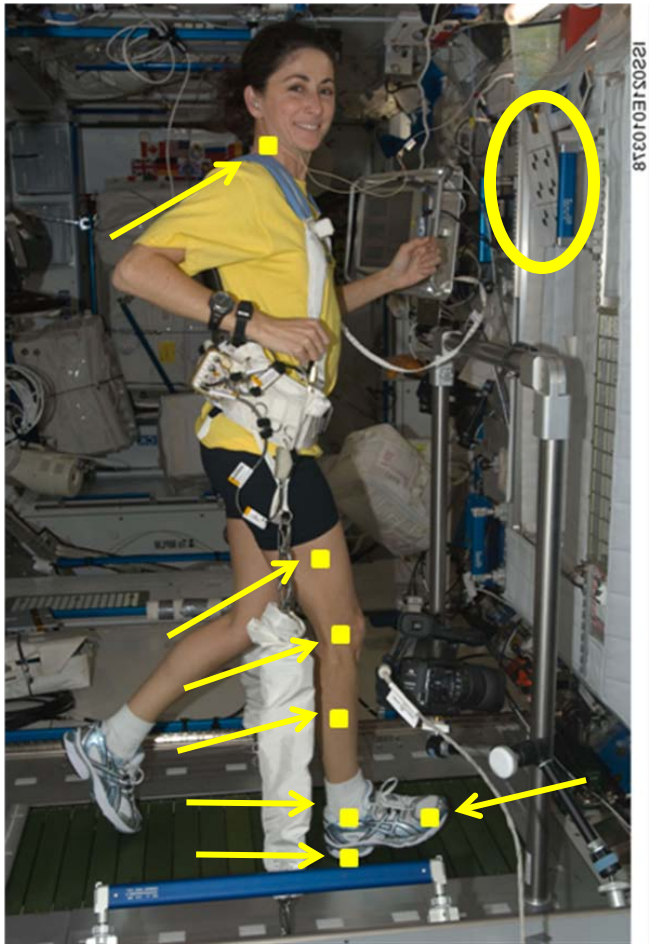
- **Data Collection**
  - **B261, Rm 138 – Biomechanics Lab**
  - **Markers placed on leg and neck**
  - **Motion capture data and force data collected**
  - **Exercise**
    - **Walk at 1.5 mph for 1 min**
    - **Walk at 2.0 mph for 1 min**
      - **Repeat for each .5 mph increment up to 12 mph, but can stop at any time**
    - **Rest at any time**

Experiment Training

Session Title	Schedule	Duration	No. Repetitions
BDC/Training	Any time preflight	75 min	1

Session Description - Inflight

- **Data Collection**
  - **Camcorder View**
    - **Positioned to view entire right side of body, including T2**
  - **Marker Placement**
    - **Right leg and side of neck**
  - **Camcorder calibration**
    - **Hold sheet in view of camcorder near area of thigh motion for 5-10 secs**



Possible Risks or Discomforts

Study is classified as reasonable risk

Potential Hazard: Muscle cramping may occur during or after the exercise tests. Muscle soreness may also occur 24 to 48 hours after exercise.

Protection to Minimize Risks:

- Subjects will be encouraged to warm-up prior to testing by performing a protocol that includes low intensity motion and flexibility exercises. After exercise testing is completed, the subjects will be encouraged to perform a cool-down that includes light stretching.

Possible Risks or Discomforts

Potential Hazard: Muscle/joint injury

Protection to Minimize Risks:

- Subjects will perform pre-testing warm-up and stretching.
- A familiarization session will be performed to instruct the subjects in proper exercise technique.

Possible Risks or Discomforts

Potential Hazard: Mild skin irritation from tape and/or motion capture markers

Protection to Minimize Risks:

- To prevent skin irritation, motion capture markers will be attached to cloth and non-adhesive prewrap to reduce the need to attach markers directly to the skin. Any attachment directly to the skin will occur using hypoallergenic adhesive.

Study Relevance

1) First assessment of the biomechanics of locomotion on the ISS treadmill and the associated joint motions and torques during exercise.

2) Will allow us to determine if specific speed, loading, and speed-loading conditions are optimal for health maintenance and improvement.