THE FUNCTIONAL TASK TEST:
RESULTS FROM THE ONE-YEAR MISSION


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During and after spaceflight there are changes in multiple physiological systems including:

- Cardiovascular function
- Sensorimotor function
- Muscle function

*How do changes in these physiological systems impact astronaut functional performance?*
1. Determine the effects of space flight on astronaut’s ability to perform mission critical functional tasks.
2. Identify the key physiological factors that contribute to decrements in functional performance to inform the design of targeted countermeasures.
Overview

• Results from spaceflight (6 months duration) and bed rest studies

• Results from the One-Year Mission
Subject Groups

Spaceflight (ISS)
13 subjects, 6-month flights

Bed Rest
Controls: 10 subjects
Exercise: 9 subjects
70 days bed rest
Testing Schedules

6 months

Pre-flight
L-180  L-60  L-30

Post-flight
R+1   R+6   R+30

Pre-bedrest
BR-12  BR-7  BR-1

Post-bedrest
BR+0  BR+1  BR+6  BR+12

70 days in bedrest
Functional Tests

Seat Egress and Walk

Ladder Climb

Hatch Opening

Object Translation

Recovery from Fall/Stand

Jump Down

Construction Activity
Functional Tasks

Seat Egress and Walk

Recovery from Fall/Stand

Object Translation

Jump Down

Ladder Climb
Functional Tasks (cont.)

Spaceflight

Bedrest-Control

Bedrest-Exercise

Construction Activity

Hatch Opening
Both space flight and bed rest subjects (control and exercisers) showed greatest deficits in functional tests with higher demand for postural stability control.
Physiological Tests

Sensorimotor
- Postural stability
- Gait control
- Fine motor control

Muscle Performance
- Force
- Power
- Work

Cardiovascular
- Plasma volume
- Heart rate
- Blood pressure
Bed rest exercise subjects show no decrement in muscle performance but still show postural instabilities

Exercise alone was not sufficient to mitigate decrements in postural control
Countermeasure Implications

• Spaceflight and bed rest subjects showed deficits in functional tests with postural challenges and sensorimotor tests of balance and locomotor control.

• Aerobic and resistive exercise *alone* was not sufficient to maintain performance.

Require an integrated sensorimotor countermeasure to mitigate postflight balance and locomotor dysfunction.
One-Year Flight

1-year duration

Pre-flight

L-180  L-60  L-30

Post-flight

R+1  R+6  R+30

1 subject
Seat Egress and Walk Test

6-months vs. 1-year

6 months, n=13
1 year, n=1

6-months vs. 1-year single subject

6 months, n=1
1 year, n=1
Recovery from Fall: Mean Sway Speed

6-months vs. 1-year

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1

Single subject
Object Translation Test

6-months vs. 1-year single subject

Preflight  Postflight

6 months, \( n=13 \)
1 year, \( n=1 \)

Preflight  Postflight

6 months, \( n=1 \)
1 year, \( n=1 \)
Construction Activity Board

6-months vs. 1-year

6 months, n=13
1 year, n=1

6-months vs. 1-year single subject

6 months, n=1
1 year, n=1
Similar to 6-month flights, the 1-year subject showed greatest deficits in functional tests with higher demand for postural stability control.
Postural Equilibrium Control

6-months vs. 1-year

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1
Fine Motor Control Test

6-months vs. 1-year

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1
Subject matched leg or arm force with a reference force displayed on computer screen (5% max force)

6-months vs. 1-year
- 6 months, n=13
- 1 year, n=1

COV = SD force output / mean force output

6 months, n=1
- 6 months, n=13
- 1 year, n=1
Lower Body: Maximum Power

6-months vs. 1-year

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1

6 months, n=1
1 year, n=1

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6 months, n=1
1 year, n=1

6 months, n=1
1 year, n=1
Upper Body: Maximum Isometric Force

6-months vs. 1-year

6 months, n=13
1 year, n=1

6 months, n=1
1 year, n=1
Preliminary Observations

1. One-year subject showed the greatest deficits in functional tests with postural challenges and in sensorimotor tests of balance control.

2. Differences did occur in some measures (postural sway speed, force control, muscle performance) but most measures did not show substantial differences between 6-month and 1-year flight durations.

3. For a single subject there does not appear to be precipitous drop in functional performance after one year - needs to be confirmed with additional subjects.
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