Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss Increment 31/32 Science Symposium

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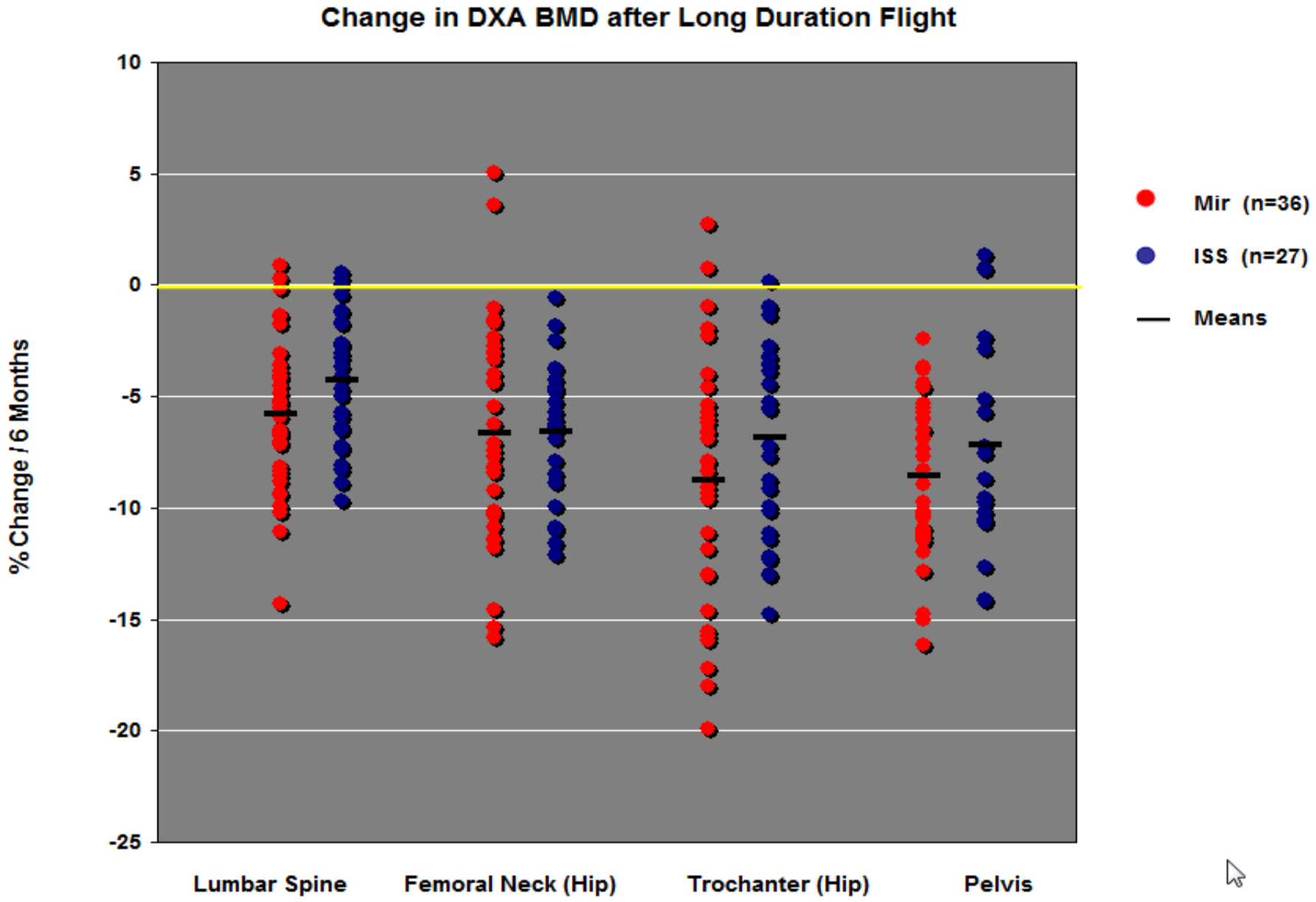
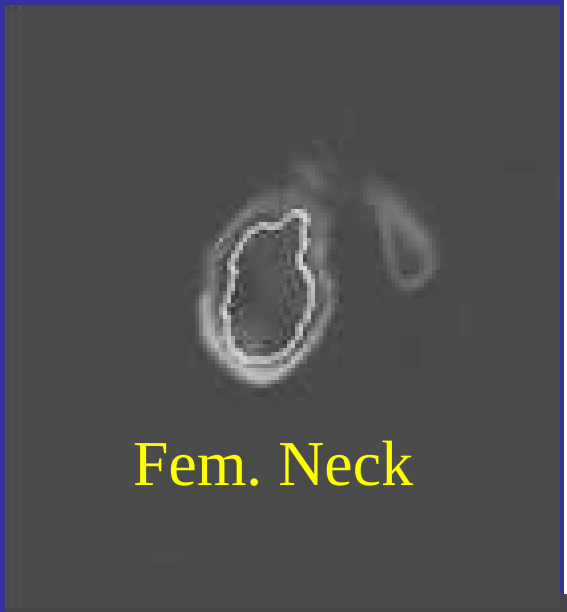
Outline

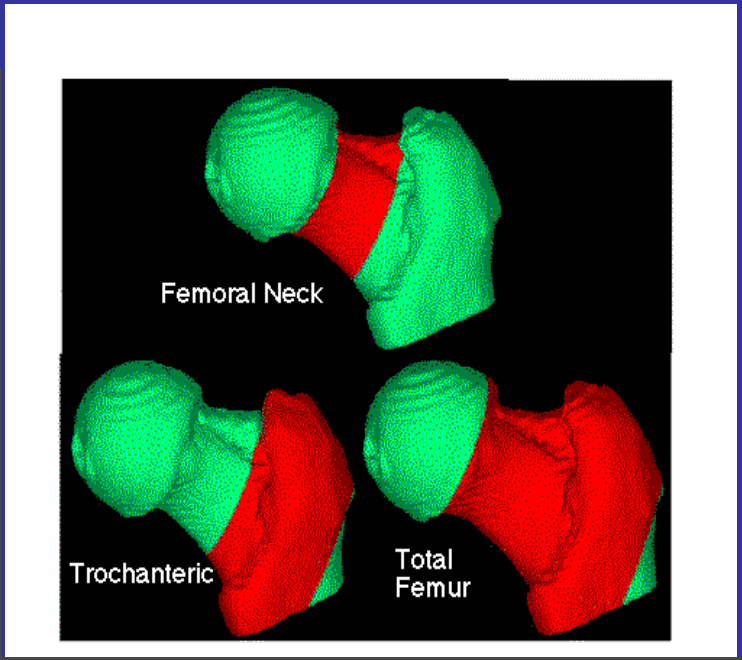
- Background-MIR, ISS
  - DXA
  - QCT
- Bisphosphonate experiment
  - Hypothesis
  - Preliminary results
- Objective of current addendum
- Measurements
- Testing constraints


Change in DXA BMD after Long Duration Flight
% Change / 6 Months
10
5
0
-5
-10
-15
-20
-25
Lumbar Spine
Femoral Neck (Hip)
Trochanter (Hip)
Pelvis
Mir (n=36)
ISS (n=27)
Means

CT Methodology



Fem. Neck



Regions of Interest

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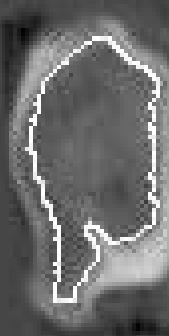

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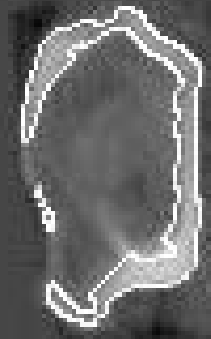

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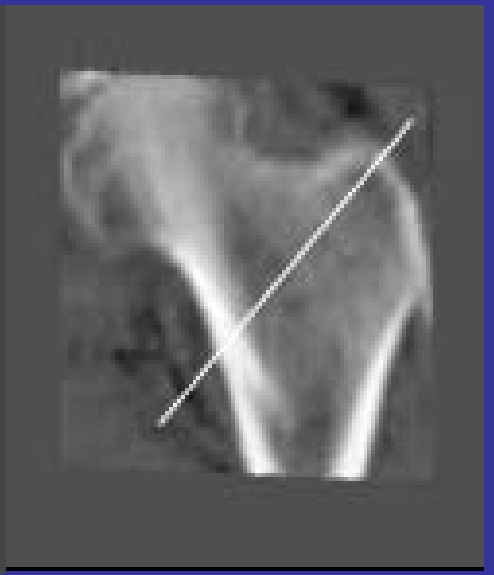
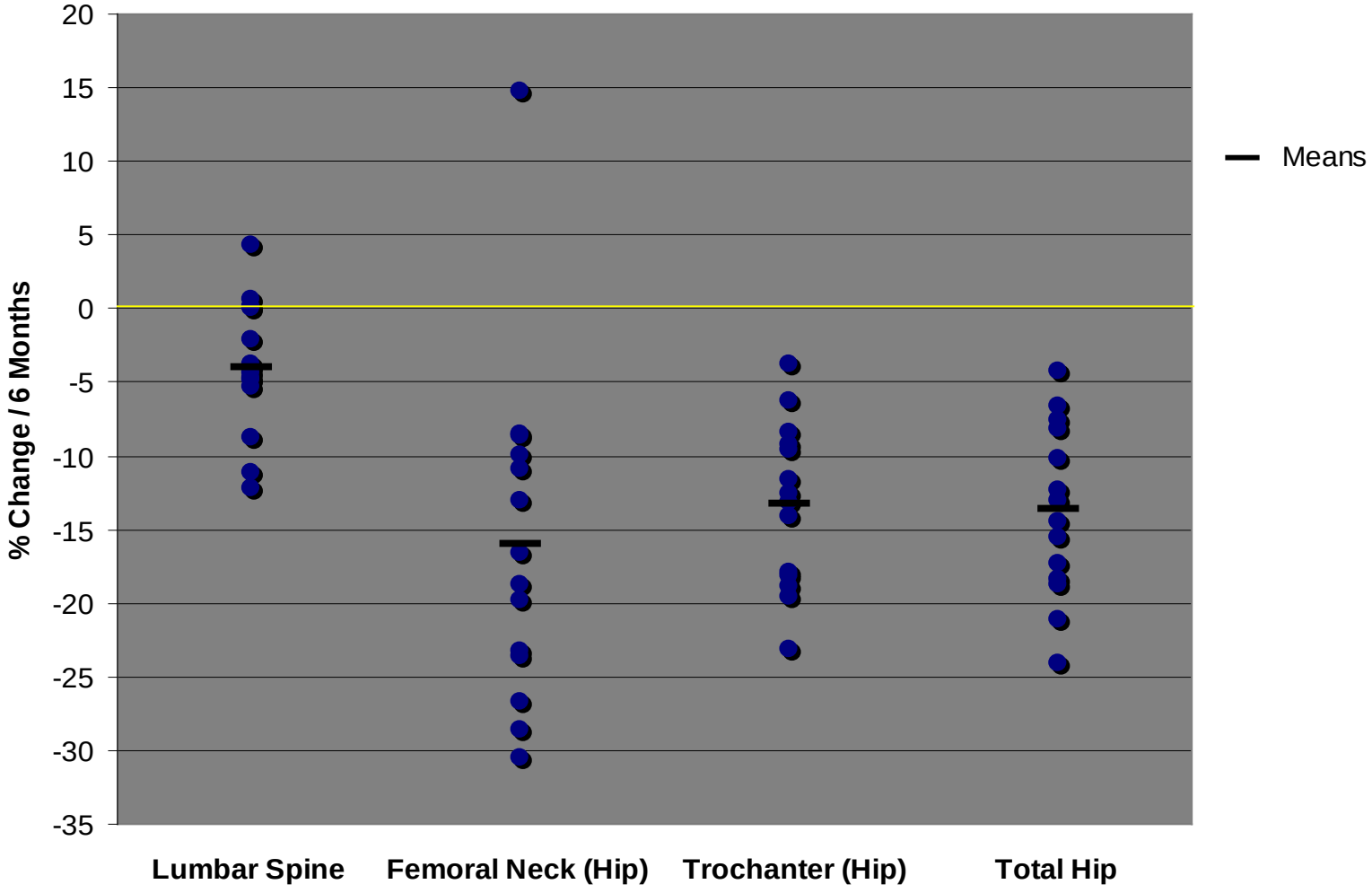


Change in QCT Trabecular BMD after ISS Flights (n=14)



Data published by T. Lang 2004

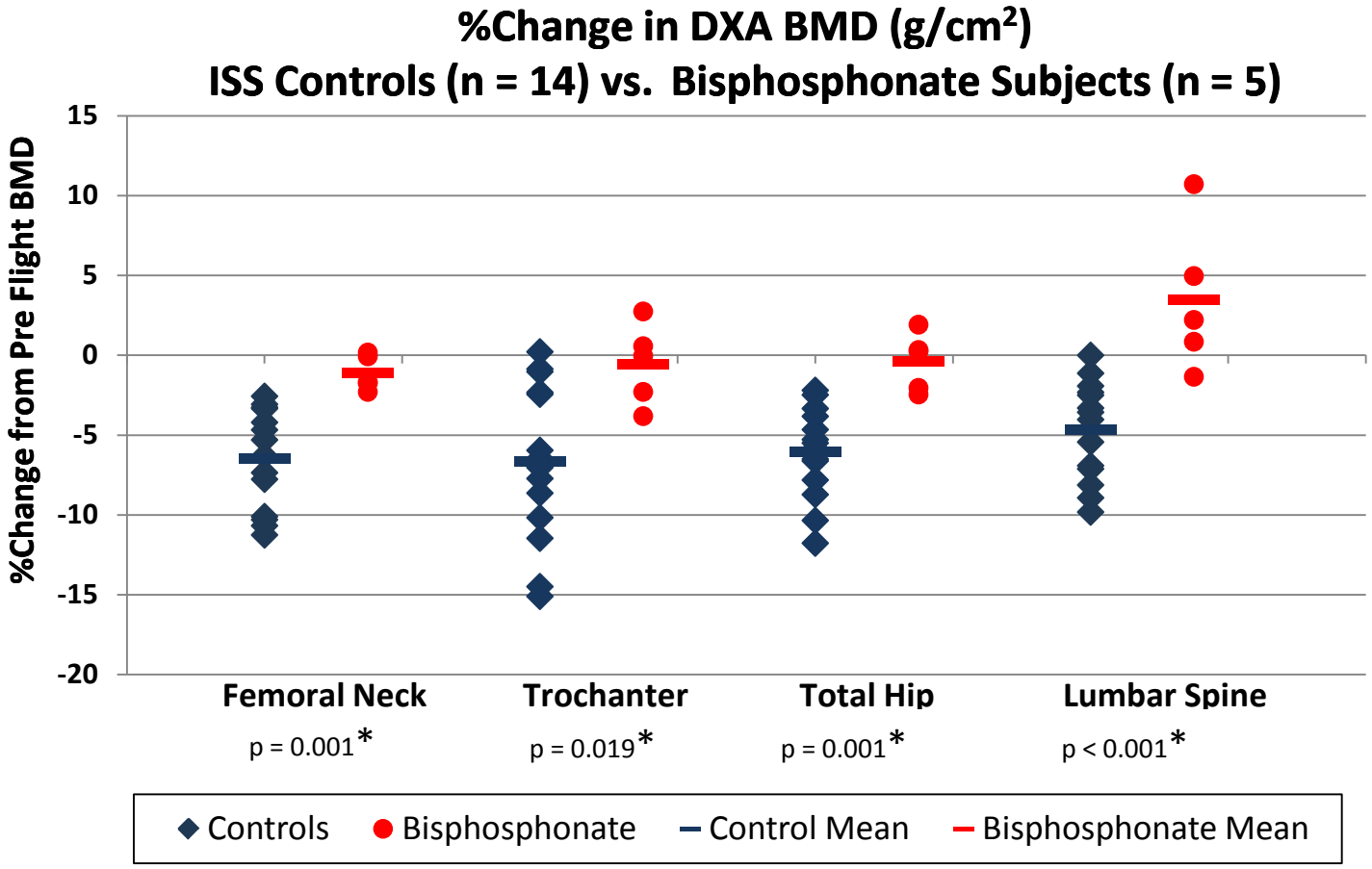
Experiment Hypothesis

The combined effect of anti-resorptive drugs plus in-flight exercise regimen will have a measurable effect in preventing space flight induced bone mass and strength loss and reducing renal stone risk.

Experiment Status

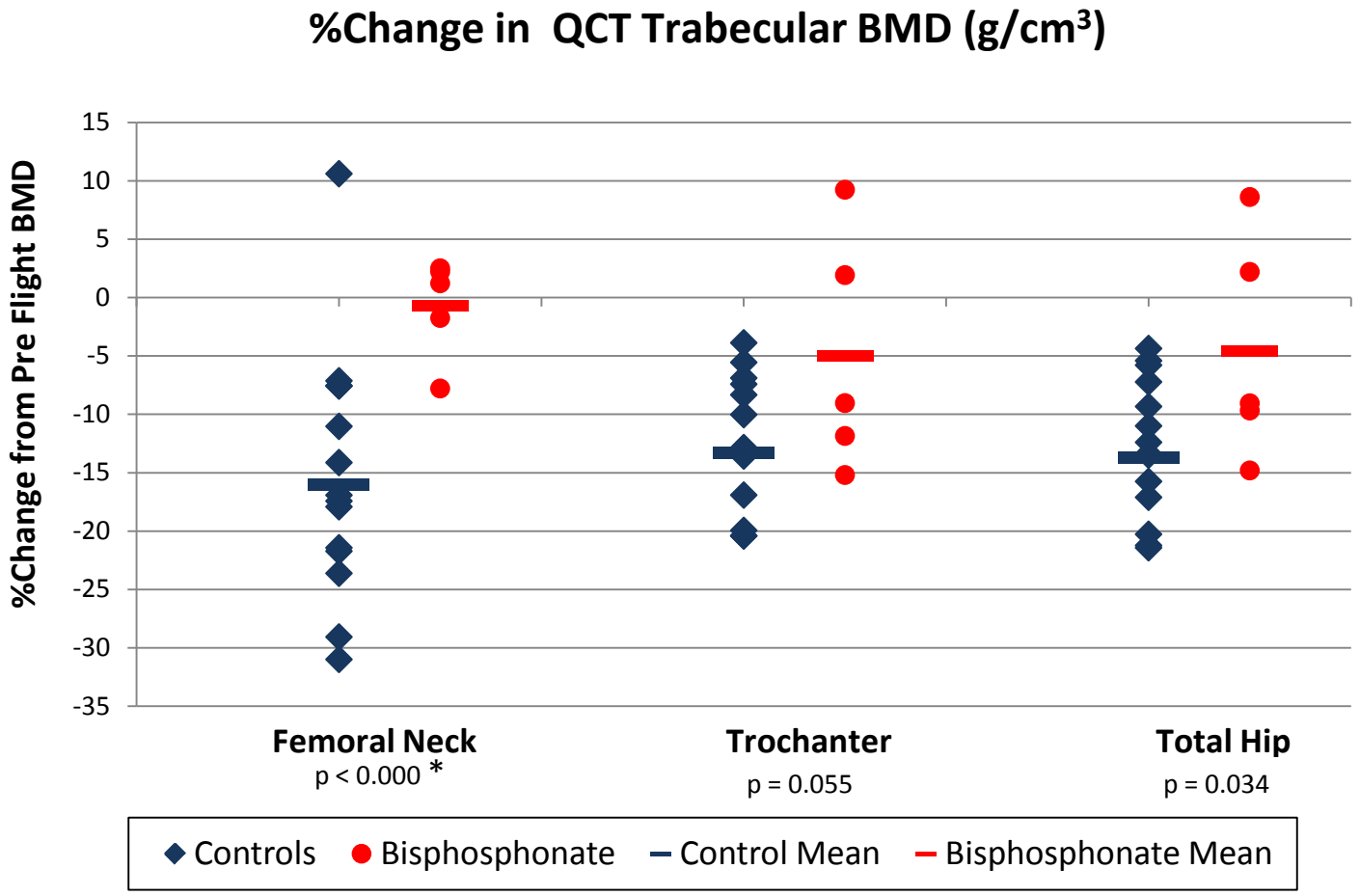
- To date 7 subjects are enrolled -- 70-mg tablet of alendronate once a week before and during flight, starting 17 days before launch
- 5 crewmembers have completed ISS long duration missions and will be reported here.
- 2 additional crewmembers are scheduled to complete the flight portion of the protocol this year

Preliminary Results



* p value statistically significant when Holm correction for multiple comparisons is applied

Preliminary Results



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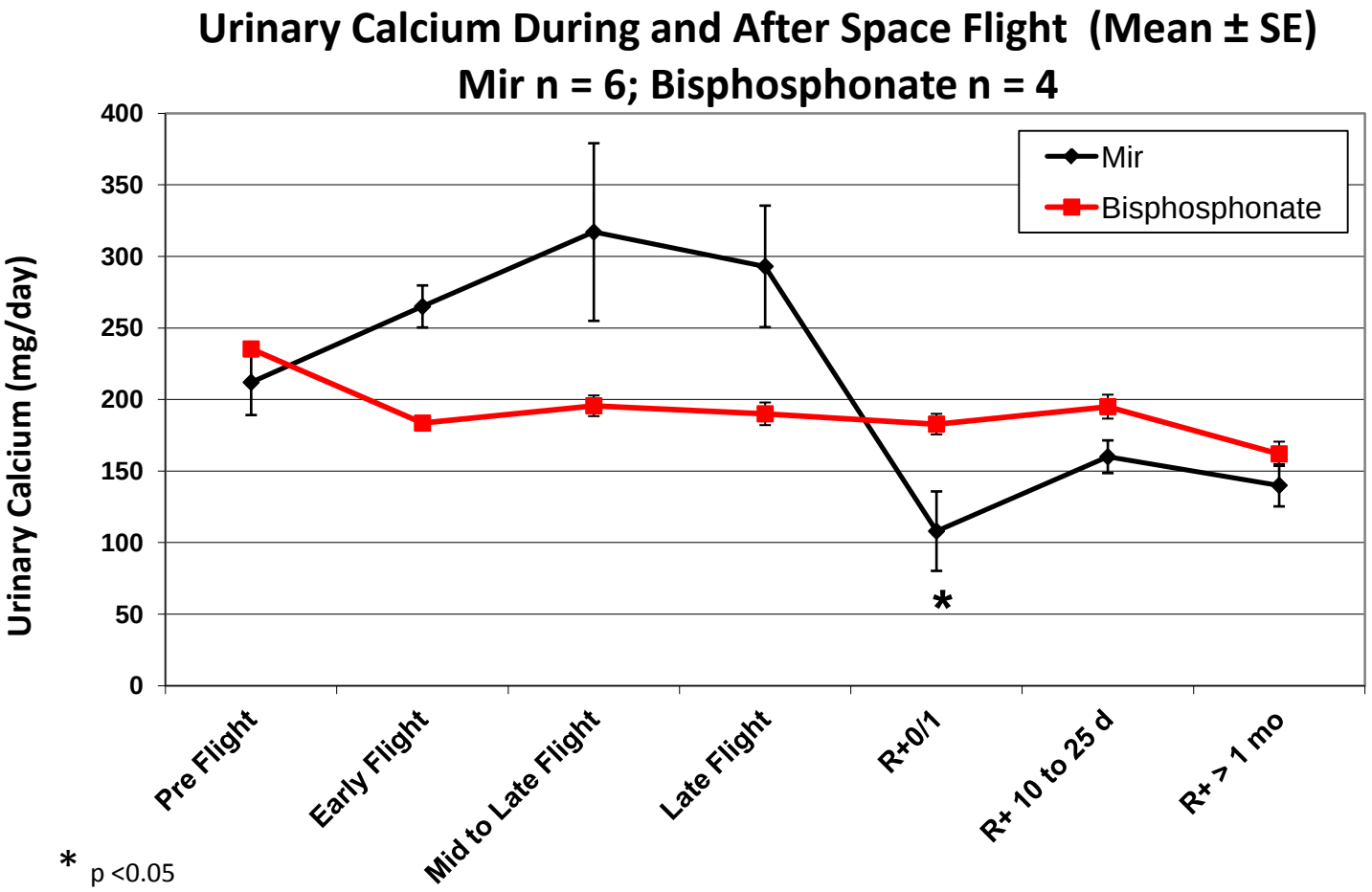

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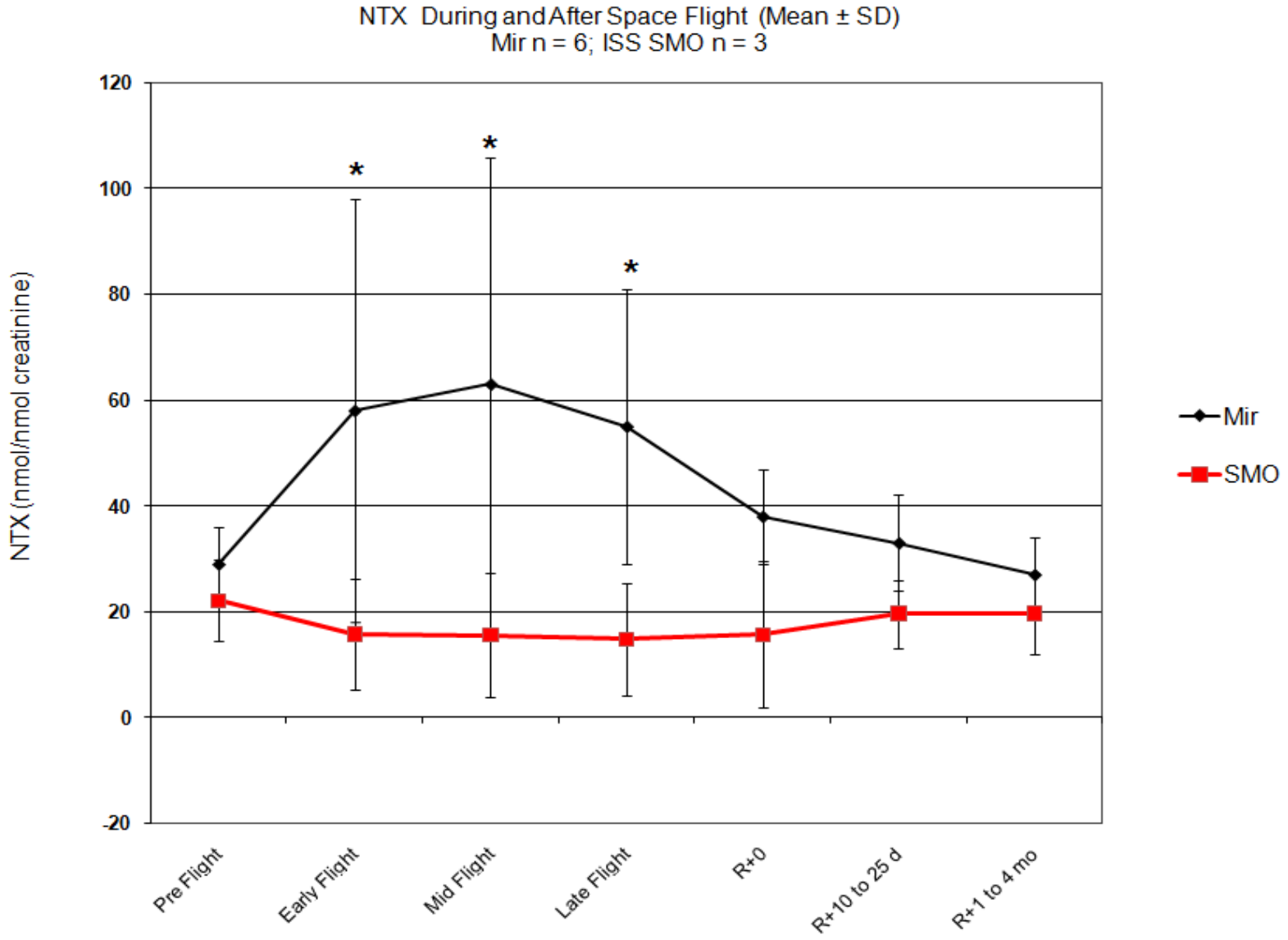

Objectives of the Current Study Extension

- Current controls are ISS astronauts who exercised using IRED.
- All subjects in the current study have used ARED, capable of higher loading and more efficient usage.
- New control group will help clarify the impact of ARED alone.

protocol

- 10 long duration ISS crew-male or female
- Exercise with ARED protocol
- Exclude subjects participating in Sprint protocol-Sprint controls can be enrolled
- Exclude subjects taking drugs targeting bone loss

Experiment Measurements

QCT: L-45 to L-30 , R+5, R+360
Imaging scan of the hip for measurement of volumetric bone density, strength modeling
Performed at local hospital
Scan takes < 15 minutes; 1 hour allotted for travel time + scanning
Can data share with Sprint study if subject is a Sprint control

DXA: L-60 to L-30, R+5, R+360
Imaging scan of the whole body, hip, spine, heel and wrist for measurement of areal bone mineral density
Performed at JSC
Scans take ~ 1 hour
Will data share with existing DXA Medical Requirement

pQCT: L-60 to L-30, R+5, R+360
Imaging scan of the lower leg (tibia) for measurement of volumetric bone density
Performed at JSC
Scans take ~50 minutes

Experiment Measurements

Urine Collections:

- L-45 , Early In-Flight, Mid In-Flight, Late In-Flight, R+0, R+30, R+360
- Levels of various markers of bone metabolism will be measured
- 24-hour void-by-void
- Can data share with Medical Requirements or other studies (e.g., Nutrition SMO)

Blood Draws:

- L-45, R+0, R+30, R+360
- Levels of various markers of bone metabolism will be measured
- Standard blood draw
- Can data share with Medical Requirements or other studies (e.g., Nutrition SMO)
- Blood draw takes < 10 minutes

Abdominal Ultrasound:

- L-30 to 180, R+30
- Imaging of bladder, ureters and kidneys for presence of renal stones
- Performed at local imaging facility
- Ultrasound takes ~ 1.5 hour, including travel time

Calcium and Vitamin D supplements:

- Vitamin D: 800 IU daily from L-45 to launch; Ca: 1000 mg daily from L-17 to launch

Test Constraints

Test	Constraints
QCT	Remove all metal (i.e., jewelry) or clothes containing metal No radioisotopes or radio opaque contrast agents for one week prior to test.
DXA	Remove all metal (i.e., jewelry) or clothes containing metal No radioisotopes or radio opaque contrast agents for one week prior to test.
pQCT	Remove all metal (i.e., jewelry) or clothes containing metal No radioisotopes or radio opaque contrast agents for one week prior to test.
Urine collections	24-hr. urine collection starts with first void of the day and concludes with first void of the following day
Blood draws	Overnight fast
Ultrasound	Overnight fast Arrive at imaging center with full bladder (drink 32 oz. of water before arrival)

Summary

Preflight	Inflight	Postflight
QCT: 60 min *		QCT: 120 min *
DXA: 60 min *		DXA: 120 min *
pQCT: 50 min		pQCT: 100 min
Blood draw: 10 min *		Blood draw: 30 min *
Urine collection: 30 min *	Urine collections: 510 min *	Urine collection: 90 min *
Abdominal ultrasound: 90 min		Abdominal ultrasound: 90 min
Ca and Vitamin D: 30 sec/day, 22.5 min total		
Total Time: 322.5 min	**Total Time: 510 min**	**Total Time: 550 min**

* Potential for data sharing with Med Requirements or other studies