

Bone Loss in Astronauts from the Flight Surgeon's Perspective

William J. Tarver, MD MPH
Medical Director, JSC Clinics

Responsibilities

- Prime directive – keep astronauts healthy
 - Patient/doctor relationship
 - Provide medical care based upon evidence based medicine using terrestrial care standards
 - PLUS our own space unique medicine
- Secondary Goal – complete the mission
 - Send them up healthy
 - Keep them healthy during the mission
 - Recondition them after the mission

The Concerns

- Selecting the proper person to be an astronaut
- Starting a mission in as good a condition as possible
- Protecting the astronauts during the mission
- Detecting, in the long-term, negative bone health outcomes due to work exposures
 - Lifetime Surveillance of Astronaut Health (LSAH)

NASA Monitoring Markers of Bone Health

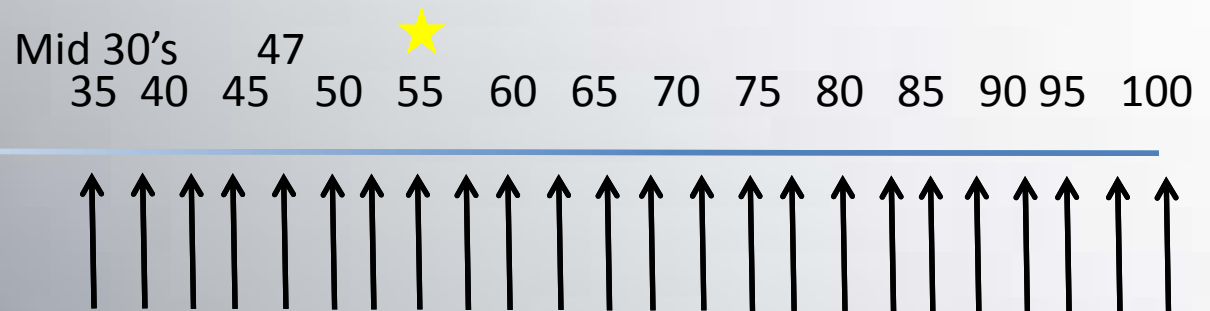
- 2-D Areal bone mineral density (DXA scan)
- Alkaline phosphatase
- Osteocalcin
- N-telopeptide (NTx)
- Vitamin D (800 IU daily on orbit dose)

Monitored every 3 years

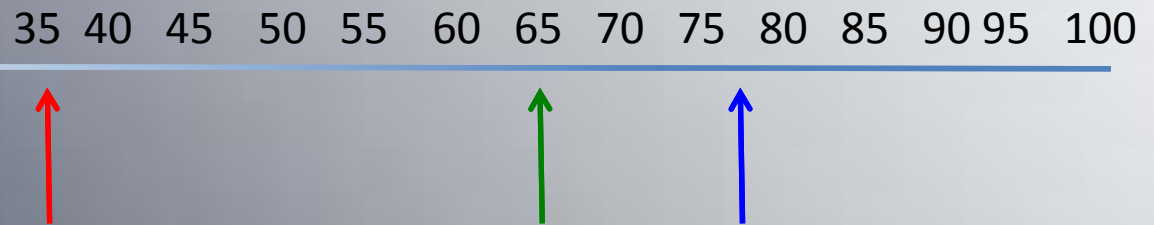
At least 2 pre-mission scans

One required post-mission scan

Astronaut



Non-Astronaut



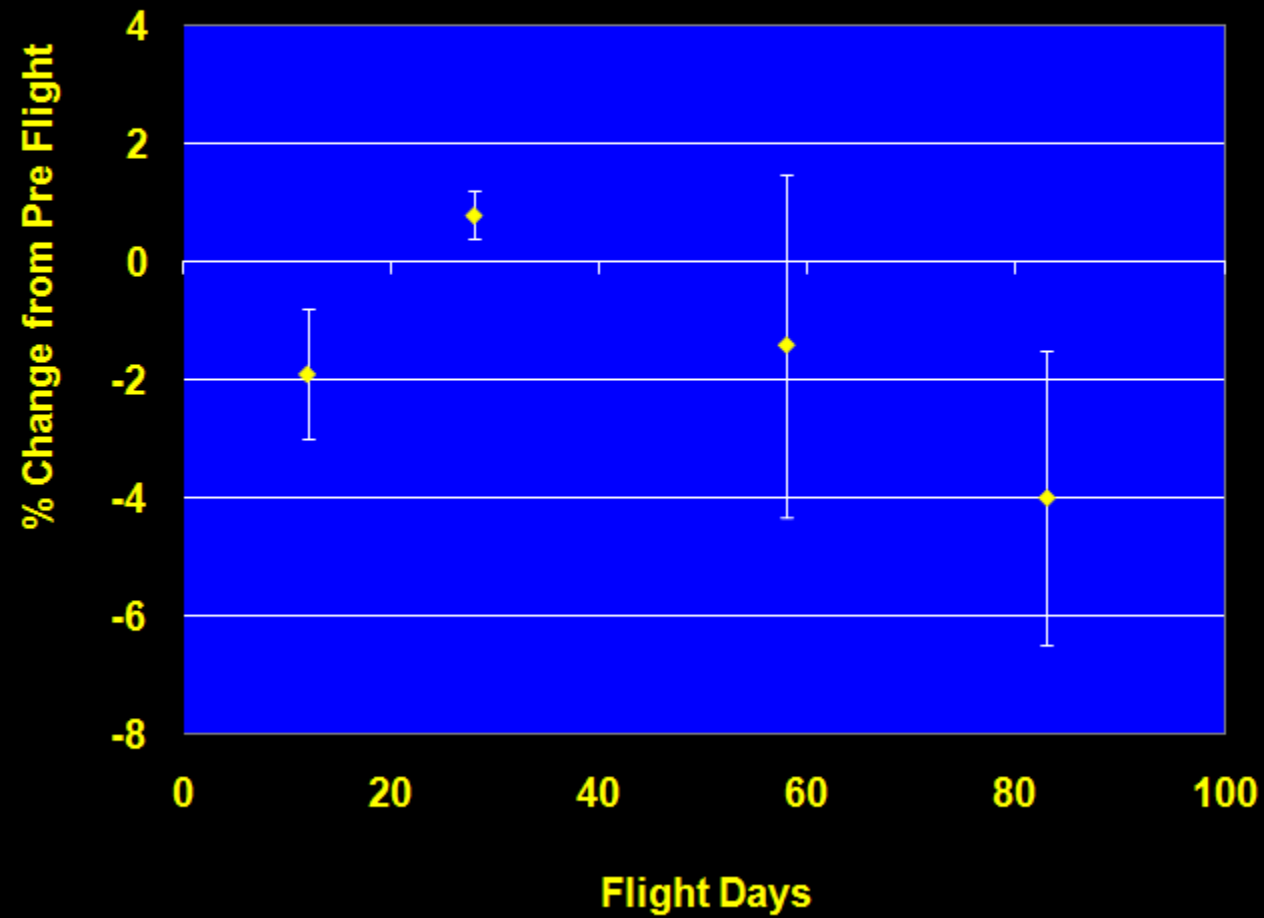
ISCD Official Position (2007)

Indications for BMD Testing

- Women aged 65 and older Postmenopausal women under age 65 with risk factors for fracture.**
- Women during the menopausal transition with clinical risk factors for fracture, such as low body weight, prior fracture, or high-risk medication use.**
- Men aged 70 and older.**
- Men under age 70 with clinical risk factors for fracture.**
- Adults with a fragility fracture.**
- Adults with a disease or condition associated with low bone mass or bone loss.**
- Adults taking medications associated with low bone mass or bone loss.**
- Anyone being considered for pharmacologic therapy.**
- Anyone being treated, to monitor treatment effect.**
- Anyone not receiving therapy in whom evidence of bone loss would lead to treatment.**

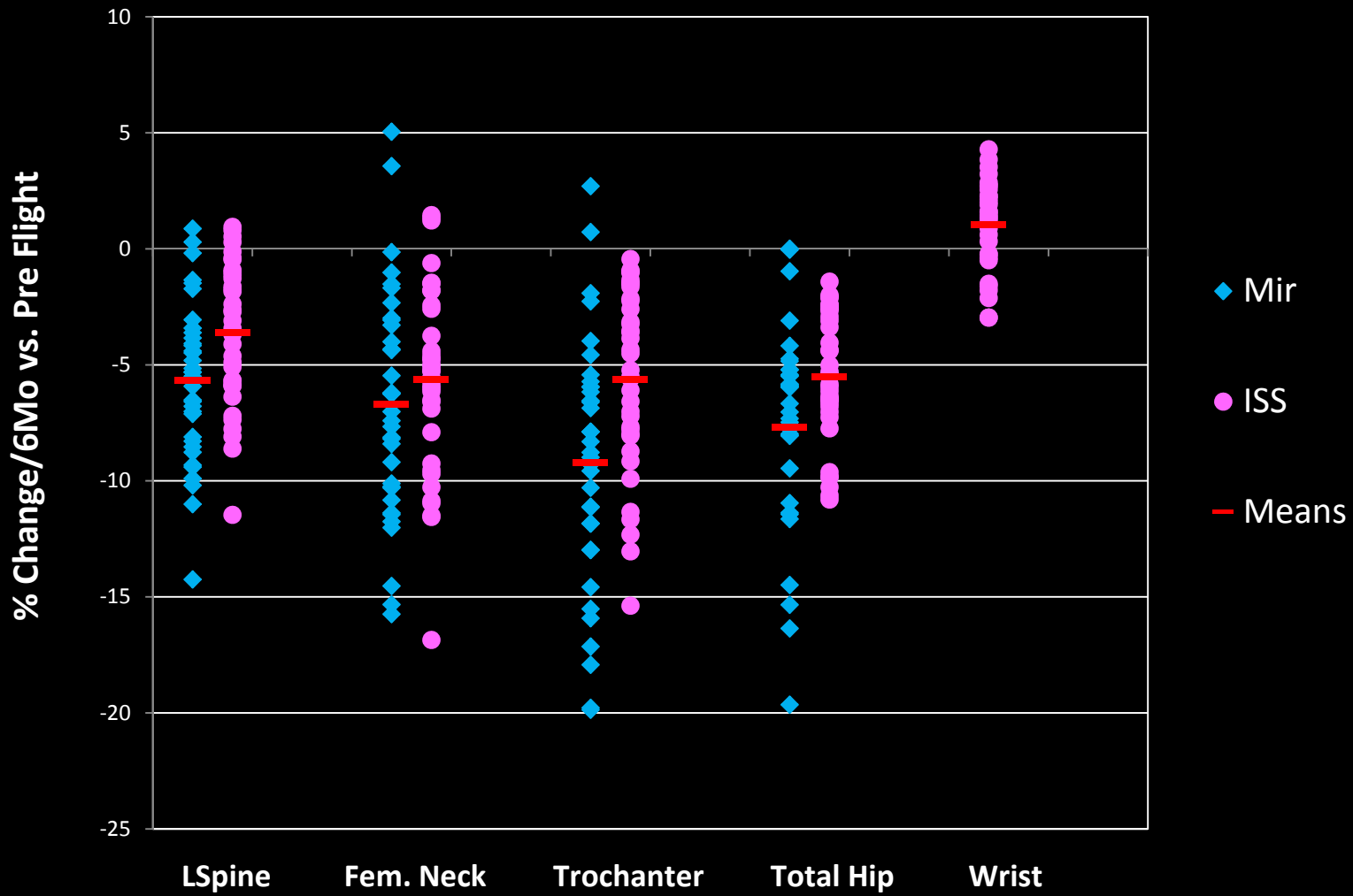


Skylab Calcaneal BMD (Mean \pm SE)

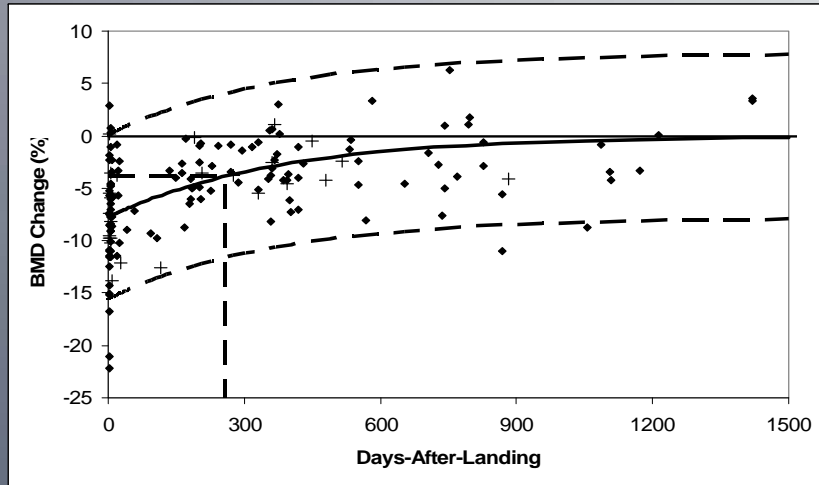


%Change in DXA BMD after Mir and ISS Missions (Normalized to 6-Month Flight)

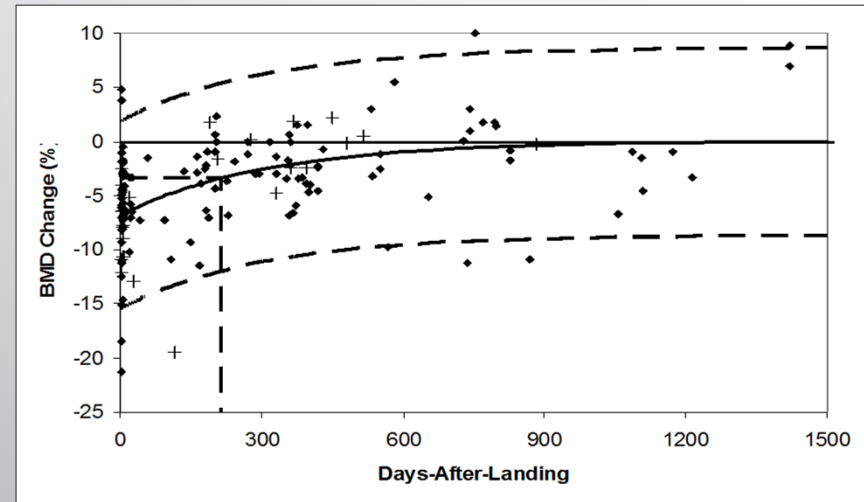
Mir n = 35; ISS n = 37



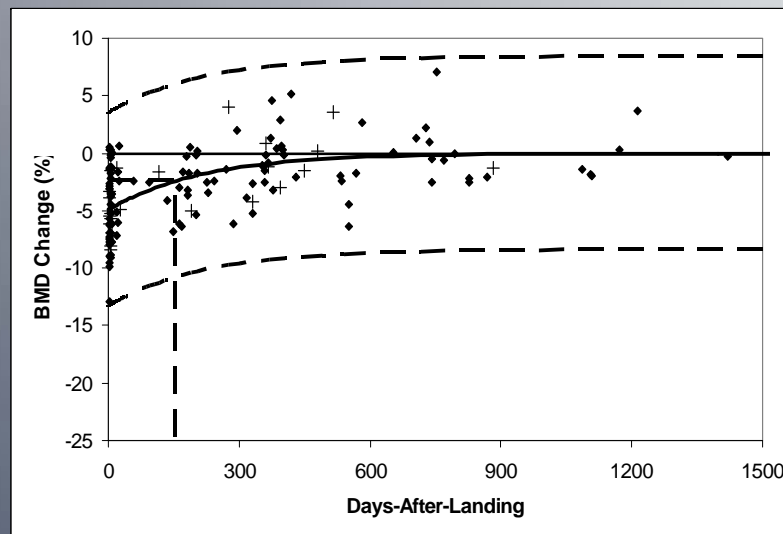
DXA BMD increases in postflight period – is that recovery?



Trochanter



Femoral neck



Lumbar Spine

Areal DXA Scan Shortcomings

- Doesn't account for geometric changes
- Doesn't provide information about trabecular bone
- No micro architecture data

WHAT TO DO?



SERIOUSLY - WHAT TO DO?



Current Bone Health Program

- DXA scans
 - Selection and then every 3 years
 - Serum bone markers every 3 years
 - Dr Steven Petak reads each scan (terrestrial)
 - Dr Linda Shackelford applies space medicine spin
- Lifetime Surveillance of Astronaut Health Program
 - Developing clinical metrics to monitor bone health