Bone Loss in Astronauts from the Flight Surgeon's Perspective

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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

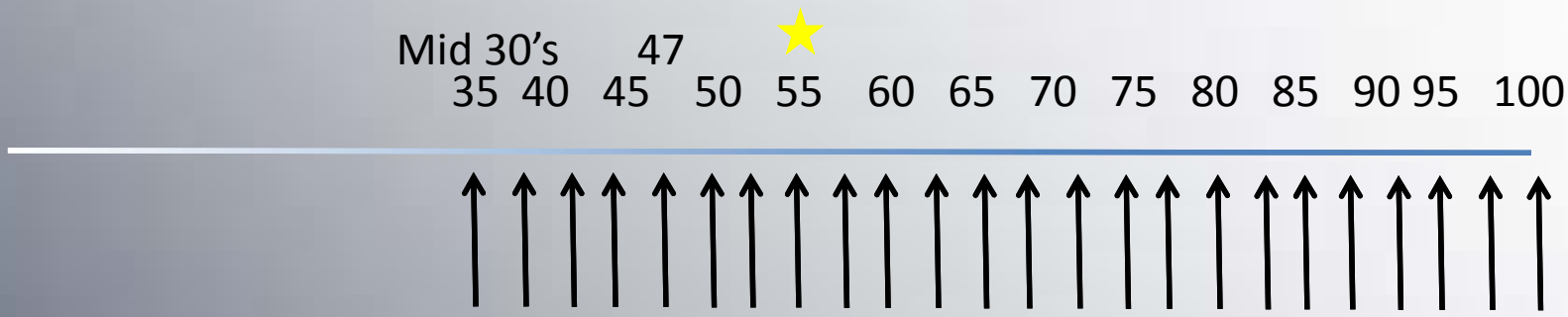
- 2-D Areal bone mineral density (DXA scan)
- Alkaline phosphatase
- Osteocalcin
- N-telopeptide (NTx)
- Vitamin D (800 IU daily on orbit dose)

Monitored every 3 years

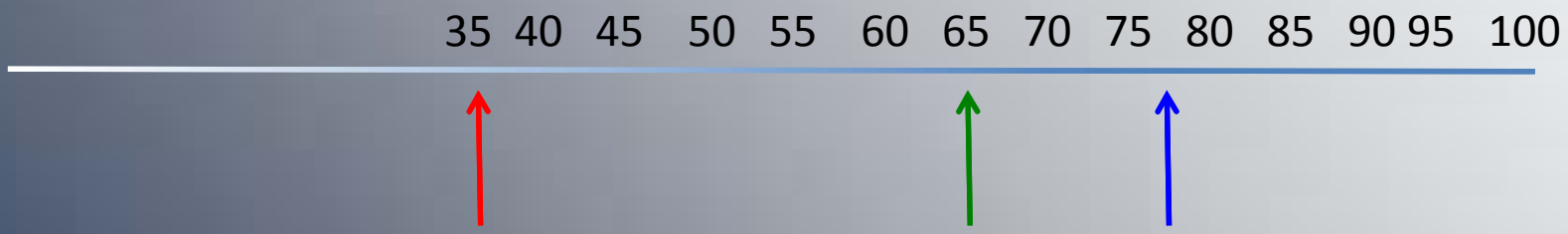
At least 2 pre-mission scans

One required post-mission scan

Astronaut

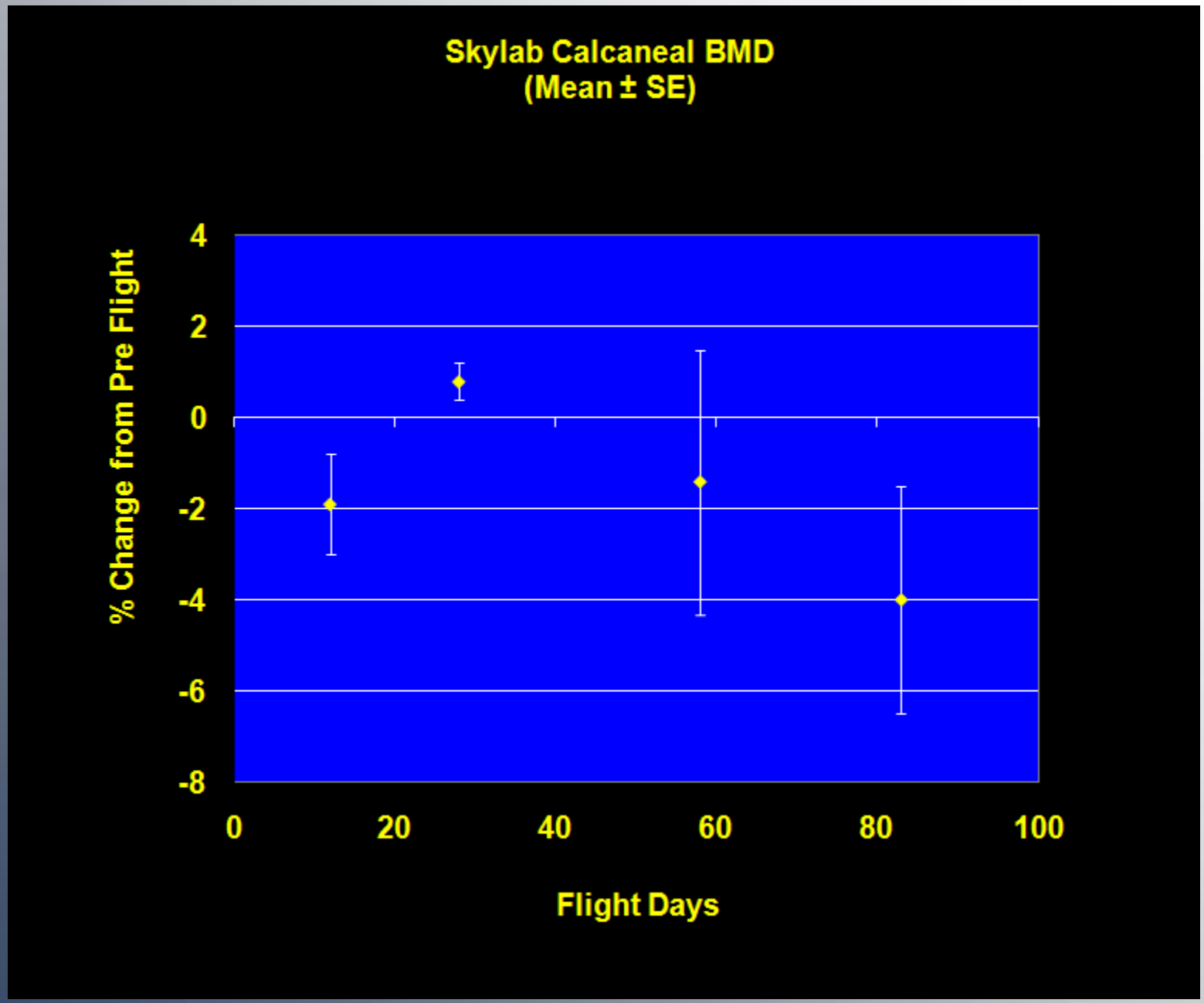


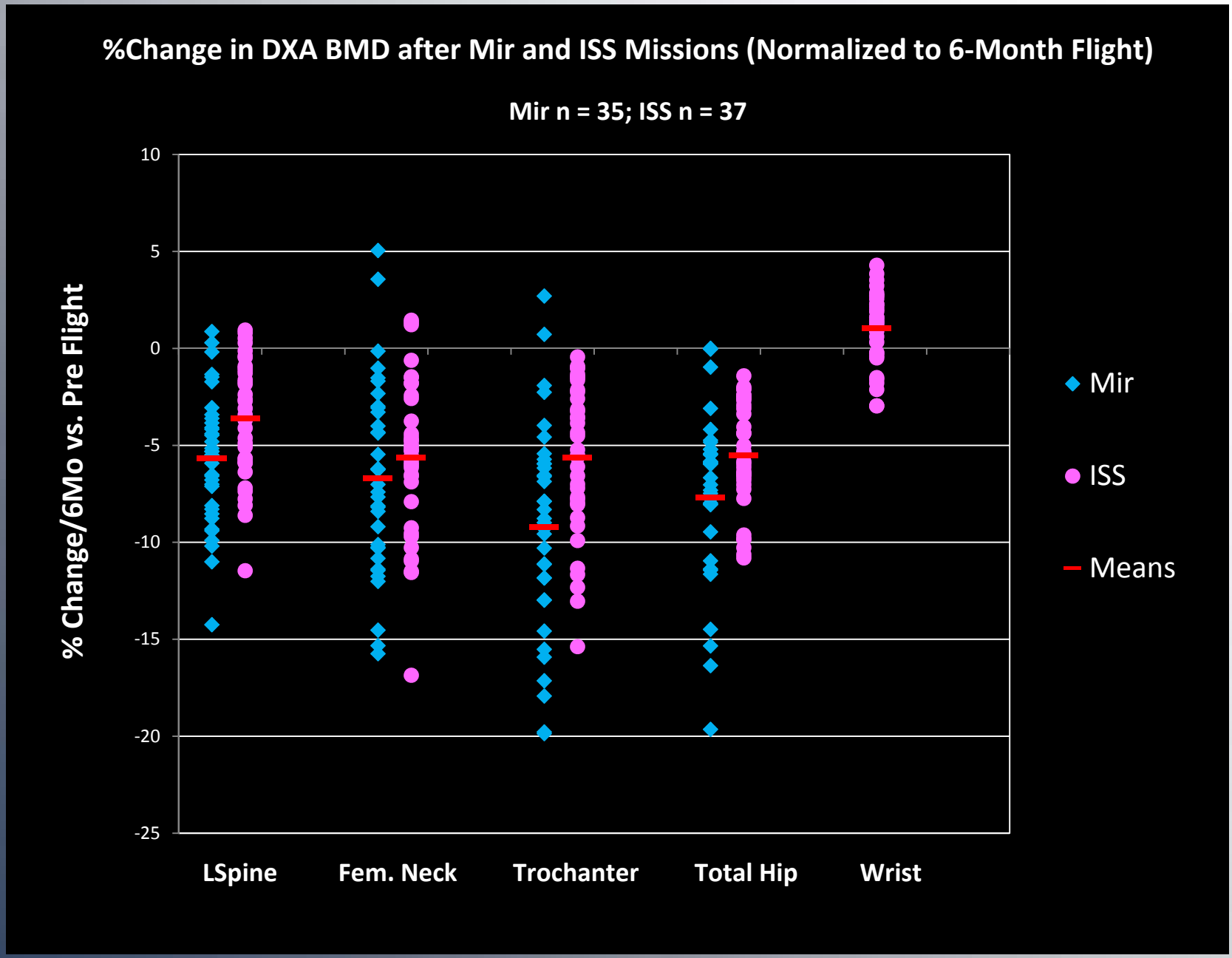
Non-Astronaut



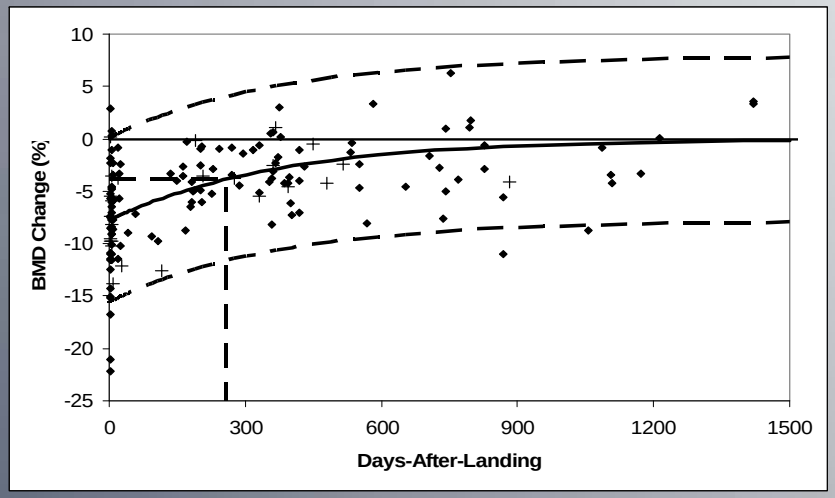
ISCD Official Position (2007)
Indications for BMD Testing

- 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.

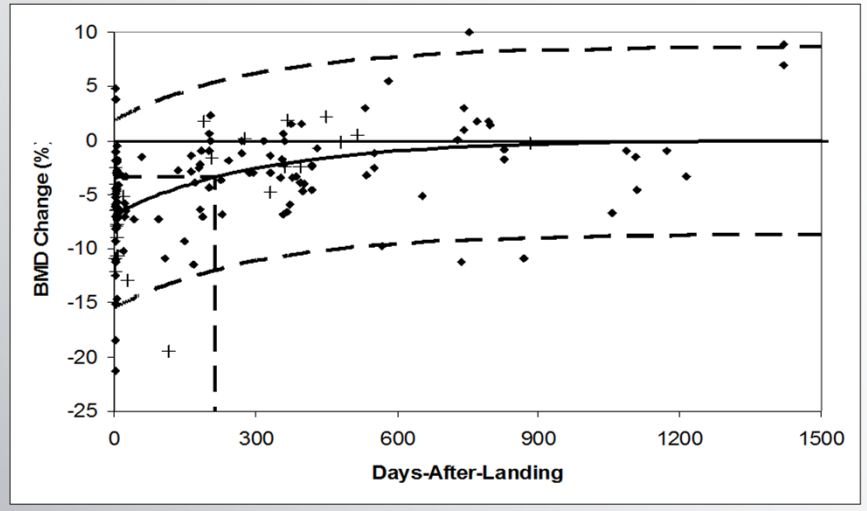

Skylab Calcaneal BMD
(Mean ± SE)
% Change from Pre Flight
4
2
0
-2
-4
-6
-8
0
20
40
60
80
100
Flight Days


%Change in DXA BMD after Mir and ISS Missions (Normalized to 6-Month Flight)
Mir n = 35; ISS n = 37
% Change/6Mo vs. Pre Flight
10
5
0
-5
-10
-15
-20
-25
LSpine
Fem. Neck
Trochanter
Total Hip
Wrist
Mir
ISS
Means

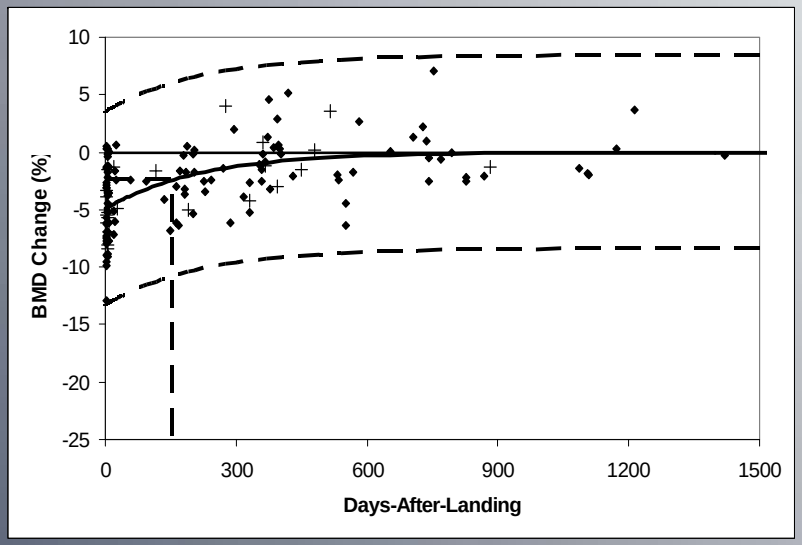
DXA BMD increases in postflight period – is that recovery?



Trochanter



Femoral neck



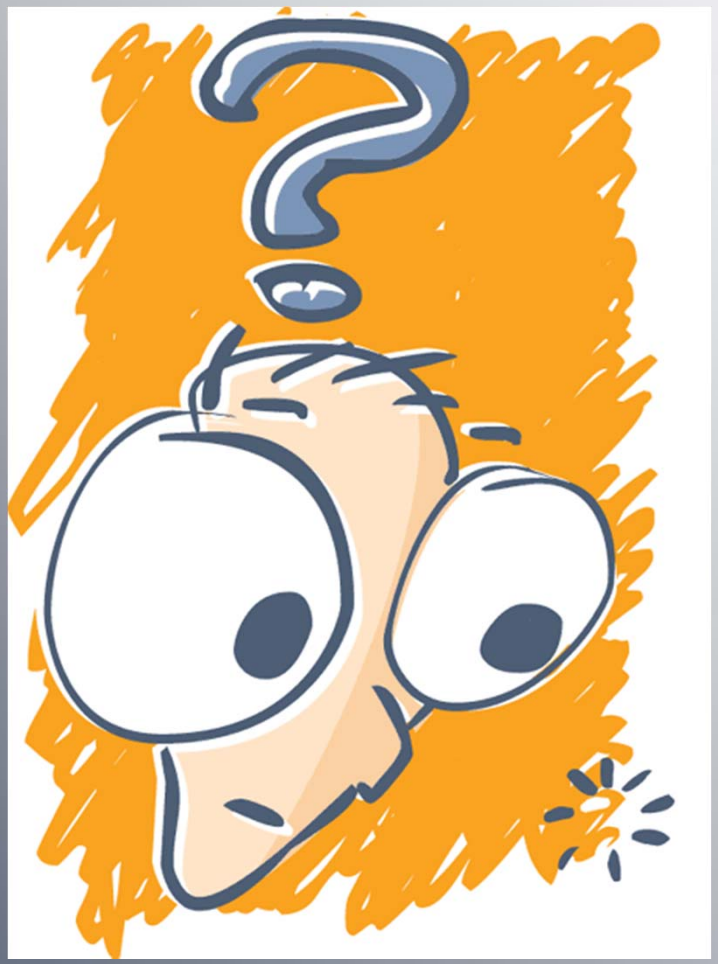
Lumbar Spine

Sibonga et al. BONE 41:973-978, 2007

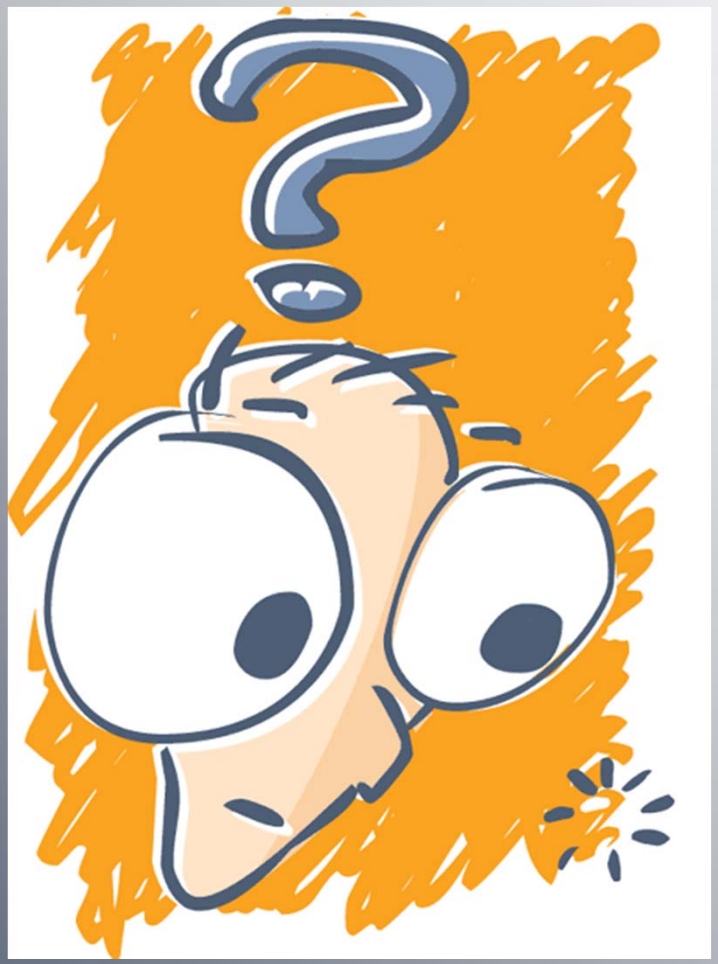
Areal DXA Scan Shortcomings

- 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 Shackleford applies space medicine spin
- Lifetime Surveillance of Astronaut Health Program
  - Developing clinical metrics to monitor bone health