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

Mid 30’s
35 40 45 50 55 60 65 70 75 80 85 90 95 100

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.
%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

Mir
ISS
Means

LSpine  Fem. Neck  Trochanter  Total Hip  Wrist
DXA BMD increases in postflight period – is that recovery?

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