Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss

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Experiment Hypothesis

The combined effect of anti-resorptive drugs plus in-flight exercise regimen will attenuate space flight induced loss in bone mass and strength and reduce renal stone risk.

Experiment Status

- To date 7 out of 10 subjects are enrolled -- all taking alendronate
- 4 crewmembers have completed ISS long duration missions without incident and will be reported here
- 3 additional crewmembers are scheduled to complete the flight portion of the protocol this year

Experiment Measurements

Bone Loss

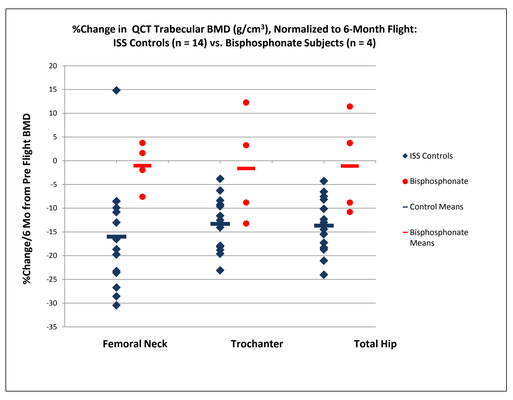
- PRIMARY ENDPOINT: Hip trabecular BMD by QCT
- Calculated bone strength of the hip by Finite Element Modeling
- Whole body and regional BMD by DXA
- Lower leg BMD by pQCT
- Serum markers of bone turnover
- Urine markers of bone turnover

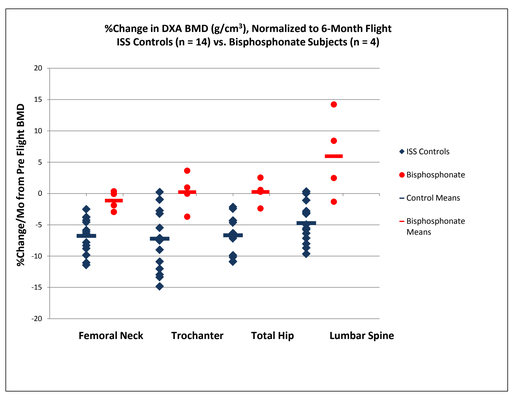
Renal Stone Risk

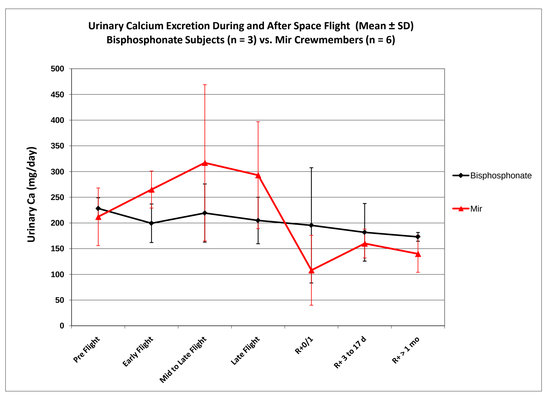
- Serum and urine renal stone parameters
- Abdominal ultrasound for renal stones

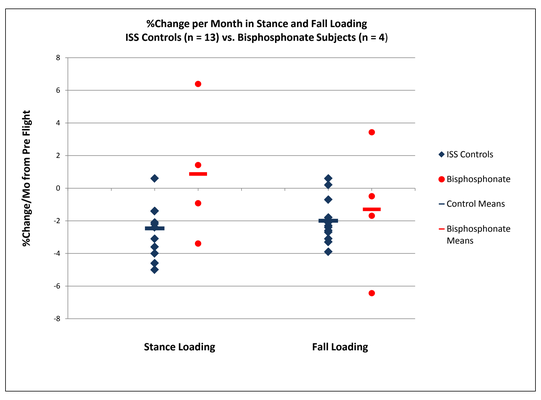
Results

Compared to previous ISS crewmembers (n=14) not taking alendronate, DXA measurements of the total hip BMD were significantly changed from -1.1 ± 0.5%/mo to 0.04 ± 0.3%/mo ($p<0.01$); QCT-determined trabecular BMD of the total hip was significantly changed from -2.3 ± 1.0%/mo to -0.3 ± 1.6%/mo ($p<0.01$). Significance was calculated from a one-tailed t-test. While these results are encouraging, the current n (4) is small, and the large SDs indicate that while the means are improved there is still high variability in individual response.









Conclusion

Current results support the hypothesis that adding an anti-resorption agent will be beneficial for bone protection -- reducing remodeling rate, bone loss, and urinary Ca and protecting bone strength.

Need more data to:

- Clarify impact of bisphosphonate countermeasure on bone strength
- Define compartmental bone loss (cortical vs. trabecular)
- Understand impact of changing exercise prescription on conclusions
- Improve precison, i.e., the predictive value for calculating benefit/risk for individual crewmembers