

Preliminary Results of Bisphosphonate ISS Flight Experiment

Adrian LeBlanc (Baylor College of Medicine); Jeff Jones (Baylor College of Medicine); Jay Shapiro (Kennedy Krieger Institute); Tom Lang (University of California at San Francisco); Linda C. Shackelford (NASA-JSC); Scott M. Smith (NASA-JSC); Harlan J. Evans (Wyle Laboratories); Elisabeth R. Spector (Wyle Laboratories); Jean Sibonga (NASA-JSC); Toshio Matsumoto (University of Tokushima Graduate School of Medicine); Toshitaka Nakamura (University of Occupational and Environmental Health); Kenjiro Kohri (Nagoya City University); Hiroshi Ohshima (Japan Aerospace Exploration Agency)

Bone loss has been recognized as a potential problem from the beginning of human spaceflight. With the spaceflight missions lasting 6 months to potentially 3 years or longer this issue has assumed increased significance. Detailed measurements from the Mir and ISS long duration missions have documented losses in bone mineral density (BMD) from the total skeleton and critical sub-regions. The most important losses are from the femoral hip averaging about -1.6%/mo integral to -2.3%/mo trabecular BMD. Importantly these studies have documented the wide range in individual response from -0.5 to -5%/mo in BMD. Given the small size of any expedition crew, the wide range of responses has to be considered in the implementation of any countermeasure. Assuming that it is unlikely that the susceptibility for bone loss in any given crewmember will be known, a suite of bone loss countermeasures will likely be needed to insure protection of all crewmembers.

The hypothesis for this experiment is that the combined effect of anti-resorptive drugs plus the standard in-flight exercise regimen will have a measurable effect on preventing space flight induced bone loss and strength and will reduce renal stone risk. To date, 4 crewmembers have completed the flight portion of the protocol in which crewmembers take a 70-mg alendronate tablet once a week before and during flight, starting 17 days before launch. Compared to previous ISS crewmembers (n=14) not taking alendronate, DXA measurements of the total hip BMD were significantly changed from $-1.1 \pm 0.5\%/mo$ to $0.04 \pm 0.3\%/mo$ ($p < 0.01$); QCT-determined trabecular BMD of the total hip was significantly changed from $-2.3 \pm 1.0\%/mo$ to $-0.3 \pm 1.6\%/mo$ ($p < 0.01$). 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. Four additional crewmembers have been recruited to participate in this experiment, with expected completion of these flights by late 2011.