

## UPDATE OF BISPHOSPHONATE FLIGHT EXPERIMENT

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Elevated bone resorption is a hallmark of human spaceflight and bed rest indicating that elevated remodeling is a major factor in the etiology of space flight bone loss. In a collaborative effort between the NASA and JAXA space agencies, we are testing whether an antiresorptive drug would provide additional benefit to in-flight exercise to ameliorate bone loss and hypercalciuria during long-duration spaceflight. Measurements of bone loss include DXA, QCT, pQCT, urinary and blood biomarkers. We have completed analysis of R+1 year data from 7 crewmembers treated with alendronate during flight, as well as immediate post flight (R+<2wks) data from 6 of 10 concurrent controls without treatment. The treated astronauts used the Advanced Resistive Exercise Device (ARED) during their missions. The purpose of this report is twofold: 1) to report the results of in-flight, post flight and one year post flight bone measures compared with available controls with and without the use of ARED; and 2) to discuss preliminary data on concurrent controls.

The figure below compares the BMD changes in ISS crewmembers exercising with and without the current ARED protocol and the alendronate treated crewmembers also using the ARED. This shows that the use of ARED prevents about half the bone loss seen in early ISS crewmembers and that the addition of an antiresorptive provides additional benefit. Resorption markers and urinary Ca excretion are not impacted by exercise alone but are significantly reduced with antiresorptive treatment. Bone measures for treated subjects, 1 year after return from space remain at or near baseline.

DXA data for the 6 concurrent controls using the ARED device are similar to DXA data shown in the figure below. QCT data for these six indicate that the integral data are consistent with the DXA data, i.e., comparing the two control groups suggests significant but incomplete improvement in maintaining BMD using the ARED protocol. Biochemical data of the concurrent control group await sample return and analysis. The preliminary conclusion is that an antiresorptive may be an effective adjunct to exercise during long-duration spaceflight.

