

## Update of the Bisphosphonate ISS Flight Experiment

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The bisphosphonate study is an international collaboration between the NASA and JAXA space agencies to investigate the potential value of antiresorptive drugs to mitigate the well-established bone changes associated with long-duration spaceflight. Our hypothesis is that an antiresorptive drug in combination with in-flight exercise will ameliorate bone loss and hypercalcuria during long-duration spaceflight. We have completed data analysis for 7 crewmembers treated with alendronate during flight and 3 of 10 controls without treatment. We previously reported the pre/postflight changes in bone density and the pre versus in-flight changes in various biomarkers in crewmembers taking alendronate during flight. The purpose of this report is to compare these results with the 12-month follow-up data. The table below presents these data as a percentage change from baseline either immediately postflight or in-flight (biochemical markers) with a 1-year follow-up.

	<i>Changes in Alendronate Treated Subjects (n=7); % Change from Baseline (mean ± SD)</i>	
	<b>R+&lt;2 week</b>	<b>R+1 year</b>
<b>DXA BMD</b>		
Total Hip	-0.2 ± 1.5	0.8 ± 1.4
Trochanter	0.02 ± 2.3	2.1 ± 1.2*
Femur Neck	-0.7 ± 1.2	1.5 ± 1.7*
Lumbar Spine	2.8 ± 4.0	3.9 ± 3.8*
<b>QCT BMD</b>		
Trabecular Total Hip	-1.1 ± 9.8	-1.1 ± 12.1
Cortical Total Hip	-0.6 ± 4.7	-2.9 ± 3.7
Trabecular Trochanter	-1.9 ± 9.9	-1.2 ± 12.4
Cortical Trochanter	-0.5 ± 5.0	-3.2 ± 4.3
Trabecular Femur Neck	6.5 ± 14.8	2.8 ± 7.2
Cortical Femur Neck	-1.0 ± 4.8	-3.9 ± 3.1*
<b>Hip Strength</b>		
Fall	-0.1 ± 7.6	-4.9 ± 4.8
Standing	0.80 ± 10.1	-2.2 ± 4.9
	<b>In Flight</b>	<b>R+1 year</b>
<b>Resorption Markers</b>		
Urinary NTX	-25.8 ± 30.1*	-29.3 ± 29.3*
Serum CTX-β	-4.8 ± 32.7	25.9 ± 102
<b>Formation Markers</b>		
BSAP	-15.0 ± 11.5	6.9 ± 34.0
Osteocalcin	1.6 ± 45.0	-8.7 ± 50.3
Urinary Ca	-17.5 ± 19.4	-2.9 ± 37.5
25(OH) Vit D	-13.5 ± 10.5	5.5 ± 37.8
1,25(OH)2 Vit D	9.8 ± 60.5	-3.7 ± 48.6
Intact PTH	35.9 ± 25.1*	6.7 ± 14.8

Abbreviations: NTX=N-terminal telopeptide, CTXB=C-terminal telopeptide, BSAP=Bone Specific Alkaline Phosphatase, PTH=Parathyroid hormone. \**P* < 0.05

These results indicate that the use of an antiresorptive plus exercise may be effective during long-duration spaceflight (previously reported: Osteoporosis Int. 24:2105–2114, 2013) and that bone measures at 1 year remain at or near baseline values.