

Fiscal Year:	FY 2014	Task Last Updated:	FY 08/29/2013
PI Name:	LeBlanc, Adrian Ph.D.		
Project Title:	Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss: SMO-021		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		TechPort:	Yes
Human Research Program Elements:	(1) HHC :Human Health Countermeasures		
Human Research Program Risks:	(1) Bone Fracture :Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) Osteo :Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	NON-PROFIT	Phone:	281-244-2012
Organization Name:	Universities Space Research Association		
PI Address 1:	Division of Space Life Sciences		
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City:	Houston	State:	TX
Zip Code:	77058	Congressional District:	22
Comments:			
Project Type:	FLIGHT	Solicitation / Funding Source:	Directed Research
Start Date:	10/01/2006	End Date:	08/31/2015
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC
Contact Monitor:	Maher, Jacilyn	Contact Phone:	
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date is 8/31/2015 per HRP Master Task List dtd 7/12/11 (Ed., 8/4/11) NOTE: Extended to 9/30/2013 per PI (Ed., 11/5/2010)		
Key Personnel Changes/Previous PI:	August 2013 Report: Dr. Joyce Keyak (University of California at Irvine) has been added as a Co-Investigator. Dr. Keyak provides expertise in the area of Finite Element Modeling using hip QCT scans, and she is a co-author of presentations and publications resulting from this flight study. Toshio Matsumoto, M.D., Ph.D., is the Japanese Co-Principal Investigator of this study, a joint project between NASA and JAXA. Dr. Matsumoto is affiliated with the Department of Medicine and Regulatory Sciences, University of Tokushima Graduate School of Medicine. His contact information is: Phone 81-88-633-7119/Fax 81-88-633-7407; Toshimat@clin.med.tokushima-u.ac.jp .		

COI Name (Institution):	Jones, Jeffrey (Baylor College of Medicine) Shapiro, Jay M.D. (Kennedy Krieger Institute) Lang, Tom Ph.D. (University of California at San Francisco) Shackelford, Linda M.D. (NASA Johnson Space Center) Smith, Scott Ph.D. (NASA-Johnson Space Center) Evans, Harlan Ph.D. (Wyle Laboratories) Spector, Elisabeth (Wyle Laboratories) Sibonga, Jean Ph.D. (Universities Space Research Association (USRA)) Nakamura, Toshitaka M.D., Ph.D. (University of Occupational and Environmental Health) Kohri, Kenjiro M.D., Ph.D. (Nagoya City University) Ohshima, Hiroshi M.D., Ph.D. (Japan Aerospace Exploration Agency (JAXA)) Keyak, Joyce (University of California, Irvine)
Grant/Contract No.:	Directed Research
Performance Goal No.:	
Performance Goal Text:	
Task Description:	<p>The purpose of this Supplementary Medical Objective is to determine whether bisphosphonates, in conjunction with the routine in-flight exercise program, will protect ISS crewmembers from the regional decreases in bone mineral density documented on previous ISS flights. Two dosing regimens will be tested: (1) an oral dose of 70 mg alendronate taken weekly during flight and (2) and I.V. dose of zoledronic acid 4 mg, administered just once approximately 45 days before flight. Our rationale for including both alendronate and zoledronic acid is that two dosing options will: maximize crew participation, increase the countermeasure options available to flight surgeons, increase scientific opportunities, and minimize the effects of operational and logistical constraints. Use of both oral and I.V. options can accommodate both crew and flight surgeon preferences (e.g., based on individual drug sensitivity, relevant health conditions, or other considerations). Operational and logistical constraints may favor one option versus the other. For example, stowage limits may limit use of alendronate on certain flights, while the ability to titrate the in-flight dose in response to on-orbit measurements of bone resorption would favor the weekly dosing regimen. Long-duration (e.g., 2+ year) missions would require in-flight re-dosing of I.V. zoledronic acid. The purpose of this study is not to test one dosing option versus the other. Rather, we intend to show that bisphosphonates-plus-exercise will have a measurable effect versus exercise alone in preventing space flight induced bone loss. Secondary goals will be to document the return to normal bone remodeling post-flight in crewmembers who took bisphosphonates.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>While the primary purpose of this research is to develop a countermeasure to protect crewmembers against bone loss during long duration spaceflight, this research may provide insight into the mechanisms and prevention of bone atrophy in other disuse conditions.</p>
Task Progress:	<p>The original intent of this study was to test 10 long-duration crewmembers taking one of two bisphosphonate regimens: either 70 mg per week alendronate or a single infusion of 4 mg of zoledronic acid. After the study began testing in 2009, the JSC CPHS determined that only alendronate would be offered to U.S. crewmembers, while both dosing options could be offered to International Partners. It was further stipulated that only 7 alendronate subjects would be allowed. We have now completed testing on all 7 of these alendronate subjects . No further subjects will be tested with bisphosphonates.</p> <p>All scheduled testing sessions for the 7 treated subjects—pre-flight, in-flight, and post-flight--have been completed. DXA, pQCT, QCT and blood and urine data have been collated and analyses of the major parameters of interest have been performed through R+30, including statistical analyses. These results were published in June 2013 in the journal Osteoporosis International (LeBlanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Shackelford L, Smith SM, Evans H, Spector E, Ploutz-Snyder R, et al. (2013). Bisphosphonates as a supplement to exercise to protect bone during long-duration space flight. Osteoporosis International 24(7): 2105-2114). In addition, results from these 7 subjects were presented in March 2013 at the NASA Human Research Program Workshop in Moody Gardens, Galveston, TX. Work continues on analysis of data through the R+12-month time point, as well as analysis of additional data parameters not previously reported.</p> <p>In 2011, the study obtained approval to add a new control group, consisting of approximately 10 ISS crewmembers not taking bisphosphonates, but otherwise participating in essentially the same pre-, in- and post-flight testing as the 7 treated subjects. The new control group should allow us to distinguish the relative effects of bisphosphonates vs. the confounder of ARED exercise, particularly at the level of trabecular vs. cortical bone. (All treated subjects in this study have used the ARED device, whereas our previous control group used the older IRED or other resistive exercise device, capable of much lower loads than ARED.) Testing on this new control group began in 2012, and, to date, 9 crewmembers have consented to participate. Of these, 3 crewmembers have returned from ISS flights and are in the process of completing post-flight testing. One additional subject will return from ISS in November 2013 and the remaining 5 will launch by the end of 2014. Informed consent briefings continue in an effort to recruit a 10th control subject and possibly 1 or 2 “insurance” subjects. It is anticipated that the control group will complete testing in approximately 2016.</p> <p>All testing to date for the first 4 control subjects, including QCT, DXA, pQCT, abdominal ultrasound and blood and urine testing, has been completed on schedule and without incident.</p>
Bibliography Type:	Description: (Last Updated: 06/29/2023)
Articles in Peer-reviewed Journals	<p>Leblanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Shackelford L, Smith SM, Evans H, Spector E, Ploutz-Snyder R, Sibonga J, Keyak J, Nakamura T, Kohri K, Ohshima H. "Bisphosphonates as a supplement to exercise to protect bone during long-duration spaceflight." Osteoporosis International. 2013 Jul;24(7):2105-14. Epub 2013 Jan 19. http://dx.doi.org/10.1007/s00198-012-2243-z ; PubMed PMID: 23334732 , Jul-2013</p>

