Fiscal Year:	FY 2005	**Task Last Updated:**	FY 04/03/2006
PI Name:	Rubin, Clinton Ph.D.		
Project Title:	Retention of skeletal, musculature, and postural status with a non-invasive, extremely low-level mechanical signal: a ground-based evaluation of efficacy		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Physiology		
Joint Agency Name:		**TechPort:**	No
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		
PI Email:	clinton.rubin@sunysb.edu	**Fax:**	FY 631-632-8577
PI Organization Type:	UNIVERSITY	**Phone:**	631-632-8521
Organization Name:	State University of New York		
PI Address 1:	Department of Biomedical Engineering		
PI Address 2:	Center for Biotechnology		
PI Web Page:	http://www.bme.sunysb.edu		
City:	Stony Brook	**State:**	NY
Zip Code:	11794-2580	**Congressional District:**	1
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2003 Biomedical Research & Countermeasures 03-OBPR-04
Start Date:	07/01/2004	**End Date:**	06/30/2008
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:	2	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Judex, Stefan (SUNY, Stony Brook) Qin, Yi-Xian (SUNY, Stony Brook)		
Grant/Contract No.:	NNJ04HA02G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The osteoporosis which develops in microgravity is one of the greatest hurdles to an extended human presence in space. Earth-based animal and human studies have demonstrated that extremely low magnitude mechanical stimuli (LMMS), if imposed at a high frequency, is strongly anabolic to the skeleton, and can serve to inhibit the bone loss, which typically parallels disuse. This experiment is designed to evaluate the efficacy of this unique biomechanical countermeasure to inhibit the disuse induced osteoporosis seen in long term bed-rest, the closest ground based equivalent of microgravity. To achieve this in a non-invasive, non-pharmacologic means would have tremendous impact not only in space, but would also address the bone loss which plagues over 20 million people world wide each year on earth. Project Aims: 1) Show that application of low magnitude (0.3g), high frequency (30Hz) mechanical stimulation, will reduce the loss of bone seen with long term disuse 2) Show that application of low magnitude, high frequency mechanical stimulation will improve the postural control of subjects undergoing long term bed-rest 3) Determine if long term bed-rest affects the sensitivity of the lower extremities. 3.b) Determine if the application of low magnitude, high frequency mechanical stimulation will inhibit the changes if they exist
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	Astronauts returning to earth have both a compromised skeletal system and a significantly impaired balance control system, which over time re-adapts to gravity. Inarguable, the loss of bone mass from extended hypogravity combined with the increase of postural instability will increase the risk of fracture. We aim to show that the daily use of brief (10m/d) low-level (0.3g), high frequency (30Hz) mechanical stimulation will reduce the degradation of the musculoskeletal and postural control systems extended disuse. Data collected at baseline show that the control group have healthy normal postural control. IN preliminary results following 90 days of bed-rest (n=4), postural control degraded f, resulting in a 68% ($p<0.05$) increase in average sway velocity and 82% ($p<0.05$) increase in maximum sway velocity, as well as a 73% ($p<0.05$) increase in total sway magnitude. These losses were paralleled by rapid deterioration of the skeletal system; each month, independent of gender (4 male, 4 female), integral BMD losses in the femoral neck, trochanter and total femur fell 1.9% ($p<0.01$), 2.6% ($p<0.005$) and 2.5% ($p<0.005$), respectively. Bedrest subjects also suffered a monthly BMD loss of 2.9% ($p<0.05$) and 2.7% ($p<0.05$) within the trabecular envelope of the trochanter and total femur. The compressive strength index (CSI), which accounts for both BMD and cross-sectional area, fell 3.8% ($p<0.005$) per month in the femoral neck and 6.1% per month ($p<0.005$) in the trochanter. No significant changes were seen in any regions of the spine. Although the exact mechanism is unknown, we are seeking to determine if our regimen of daily vibration treatment will improve the postural control and reduce bone loss after disuse when compared to controls. If the retention of balance control and bone quantity/quality in astronauts can achieved without pharmacologic treatment, there are multiple benefits. Firstly, the astronauts will be more able to safely and effectively complete tasks upon re-entry to a gravity environment. Secondly, if their postural control is improved, they are at a lower risk of falling. Considering the loss of bone seen in long term hypogravity, a reduction in the risk of falling will result in a reduction in the risk of bone fracture. If the treatment is also successful in the treatment of the loss of bone, then the risk of bone fracture from extended hypogravity will be reduced even more significantly. Following one year of support, preliminary data have been collected from bedrest subjects (control), as the first stage in evaluating efficacy of a unique, non-pharmacologic countermeasure for disuse osteoporosis--extremely low magnitude mechanical stimuli (LMMS), or, vibration. This low magnitude (0.3g), high frequency (30Hz) mechanical signal has been shown to be anabolic to bone. Work will continue in the second year to collect baseline, 60d and 90d data from controls and subjects subject to 10 minutes per day of the vibration stimulus.
Bibliography Type:	Description: (Last Updated: 10/22/2009)
Abstracts for Journals and Proceedings	Rubin C, Adler B, Muir J, Lee B, Qin Y-X, Judex S. "A low intensity mechanical countermeasure to prohibit osteoporosis in astronauts during long-term space flight." Bioastronautics Working Group, Galveston, TX, December, 2004. Bioastronautics Working Group, Galveston, TX, December, 2004. , Dec-2004
Presentation	Rubin C, B. Adler, J. Muir, B. Lee, Y-X Qin, and S. Judex. "A low intensity mechanical countermeasure to prohibit osteoporosis in astronauts during long-term spaceflight." Bioastronautics Working Group, Galveston, Tx. December, 2004. Dec-2004