Fiscal Year:	FY 2010	**Task Last Updated:**	FY 08/31/2010
PI Name:	Hargens, Alan R. Ph.D.		
Project Title:	Risk of Intervertebral Disc Damage after Prolonged Space Flight		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Dynamic Loads**:Risk of Injury from Dynamic Loads (2) **IVD**:Concern of Intervertebral Disc Damage upon and immediately after re-exposure to Gravity [inactive] (3) **Medical Conditions**:Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (4) **Renal Stone**:Risk of Renal Stone Formation		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	La Jolla	**State:**	CA
Zip Code:	92037-0863	**Congressional District:**	52
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2009 Crew Health NNJ09ZSA002N
Start Date:	07/01/2010	**End Date:**	06/30/2013
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
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Flight Program:	Pre/Post Flight		
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Chang, Douglas (University Of California, San Diego) Haughton, Victor (University Of California, San Diego) Lotz, Jeffrey (University Of California, San Francisco) O'Neill, Conor (Self)		
Grant/Contract No.:	NNX10AM18G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Our proposal is a Flight Definition Study that will use state-of-the-art imaging technologies to quantify morphology, biochemistry, metabolism, and kinematics for lumbar discs of crew members before and after prolonged space flight. Importantly, we will correlate these data with low back pain that spontaneously arises in space so as to establish pain and disc damage mechanisms that will serve as basis for future countermeasure development. After successful completion of our investigation, we will deliver a comprehensive database of microgravity-induced intervertebral disc and vertebral changes (type and magnitude) and a prioritization of these changes as to their deleterious effects and risks for crew member injury based on clinical findings. We hypothesize that spontaneous space-flight back pain and disc herniation are due to biomechanical and biological pathomechanisms. First, microgravity leads to higher than normal physiologic disc swelling and increased disc height that may stiffen the lumbar motion segment and cause abnormal segmental movement patterns. These biomechanical changes increase risk for annular rupture, vertebral endplate microfracture, and facet joint capsule strain. Second, increased disc swelling may alter nuclear matrix osmotic pressure and nutrient transport from endplate capillaries in adjacent vertebra. These biological changes adversely affect disc cell metabolism, causing pain and inducing disc matrix degradation. Our project directly addresses the Critical Path Roadmap Risks and Questions for NASA regarding disc injury (IRP Gap-B4): Is damage to joint structure, intervertebral discs, or ligaments incurred during or following hypogravity exposure? The goal of this research is to comprehensively characterize space-flight induced changes in disc morphology, biochemistry, metabolism, and kinematics. These data will be correlated with measures of back pain intensity and disability. Crewmembers will be imaged twice pre-flight (over a one-month time frame) to establish baseline data and to characterize measurement repeatability. After long-term microgravity exposure (180 days on ISS), crewmembers will be studied while maintaining supine posture as soon as possible after return to 1-G in order to quantify the acute effects of prolonged space flight. Also, pre- and post-flight, they will don a compression device so that MR images are obtained before and after 50% axial body weight load. This compression device loads the spine and simulates 50% BW load (not including loads from muscles) on the lumbar spine in upright posture. Subsequently, crewmembers will be tested after 3- and 6-months of re-adaptation to 1-G in order to distinguish immediate and longer-term recoveries. Our proposed measures represent a comprehensive set of tests that evaluate exposure severity, potential injury mechanisms, and pain generator localization. Our research will aid understanding of spinal pain and deconditioning during prolonged microgravity and of the higher incidence of disc prolapse or herniation following re-exposure to 1-G with a long-term view to prevent such spinal deconditioning with exercise or other physiologic countermeasures.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2010.
Bibliography Type:	Description: (Last Updated: 10/31/2023)