Fiscal Year:	FY 2009	Task Last Updated:	FY 06/25/2009
PI Name:	Dulchavsky, Scott A. M.D., Ph.D.		
Project Title:	Ultrasound Fracture Diagnosis in Space		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline Element/Subdiscipline:	HUMAN RESEARCHOperational and clin	ical research	
Joint Agency Name:		TechPort:	Yes
Human Research Program Elements:	(1) ExMC :Exploration Medical Capabilities		
Human Research Program Risks:	 (1) Medical Conditions: Risk of Adverse He that occur in Mission, as well as Long Term (2) Renal Stone: Risk of Renal Stone Format 	Health Outcomes Due to Mission E	
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	sdulcha1@hfhs.org	Fax:	FY 313 916 9445
PI Organization Type:	PUBLIC SERVICE	Phone:	313 916 9306
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City:	Detroit	State:	MI
Zip Code:	48202-2608	Congressional District:	13
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2007 Crew Health NNJ07ZSA002N
Start Date:	08/15/2008	End Date:	08/14/2011
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
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	None		
COI Name (Institution):	Amponsah, David (Henry Ford Hospital) Hamilton, Douglas (Wyle) Knuth, Thomas (Henry Ford Hospital) Sargsyan, Ashot (Wyle)		
Grant/Contract No.:	NNX08AV74A		
Performance Goal No.:			

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3. Develop patter reception algorithms to allow astronauts to autonomously diagnose skeletal fracture. Methods: Specific Ain 1: The accuracy of ditrascond will be evaluated against X-ray in a large cohort of acticly injured pattern at the I yeal 1 tranancenter at Henry Ford Hospital. (Hassand examinations will be performed by experts in parallel discuss) and accuracy in the discuss about Cara accuracy in the determination. Specific Ain 2: A computer based ditrascond mining program will be developed for astronauts to allow factority indications about Cara accuracy in the determination. Specific Ain 3: A computer based ditrascond faignostic capabilities will he developed for astronauts to allow factority finding and terminy finding the sheet of accuracy in the developed for astronauts by combining care an reference image, upoperpibul ultrascond d keed on this research activity demonstrates that point of care ultrascond diagnostic capabilities will he developed for astronauts by combining care arrive fracture diagnostic ungabilities will he developed for astronauts by combining care arrive fracture diagnostic ungabilities will and exceeding the discussion diadnes of the accuracy and discussion diadnes and transmiter discussion diadnes and the sheet of the discus		counter-measures. The radiographic capabilities of future spacecraft are unknown, however, ultrasound is currently operational on the ISS. Preliminary investigations have shown that ultrasound can reliably diagnose long bone fractures. This proposal will evaluate the accuracy of ultrasound in the diagnosis of bony fractures and develop just in time, training methods to allow astronauts to perform and interpret skeletal ultrasound to answer the specific aims:		
Methods: Specific Aim 1: The accuracy of ultrasound will be evaluated against X-ray in a large cohort of acutely injured patient in the Level Turnam center al Hump (red Hospital). Ultrasound examinations will be performed by experts in panelle with attornant equivalents on patient with a history and exam consistent with body instructions being exist by the detail, and has/foot herbingsen. The sense sense acutely and be detail, and has/foot herbingsen. The sense sense acutely and be detail, and has/foot herbingsen. The sense sense acutely and be detail, and has/foot herbingsen. The sense sense acutely is the base is accussed to be house a construction of be detail. Am 3: Autonomous altanoound diagnostic capabilities will be developed for attornauts by exhibing con- ditions by the reperiments. Specific Aim 3: Autonomous altanoound diagnostic capabilities will be developed for attornauts by exhibing ex- dition acute acutely is a sense sense and the sense acutely is a sense sense and the sense diagnostic by the reperiments. Specific Aim 3: Autonomous alternoound diagnostic capabilities will be developed for attornauts by exhibing ex- dition acutely in patient example. The developed for attornaut by exhibing ex- dition acutely in patient example acutely in the sense and the sense activity demonstrates that point of care alternauts diagnostic by the operators. Rationale for HRP Directed Research: An interim analysis of the prediminary data to date in this research activity demonstrates that point of care alternauts by non-experts in rapid/ acuters, and reproducible to dagoos existing to the matchologic images to allow facted and acuter in rapid acuters. The expended for two in the pre-torquid secting in the sense in a state distribution. The sense activity data to date in this research activity demonstrates that point of care alternautor by non-experts in rapid/d acuters. The secontal data point in thermin allows in there i		2. Develop training programs to facilitate skeletal ultrasound to exclude fracture.		
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Research Impact/Earth Benefits: prone-experts to aripidly diagnose injurius to the upper and lower extremitics, chest, and handsfeet to guide therapy. This technique can be expanded for use in the pre-hospital setting, in military conflicts, and in natural disasters to aid triage decisions. FEASIBILTY REVIEW Proposal Title: "Ultrasound Fracture Diagnosis in Space"; Proposal Number: 07-HRP-20009 (from NASA Research Announcement NN0725X002N); PI: Scott Dulchavsky, Henry Ford Hospital; Douglas Imaliton, Wyle Integrated Science and Engineering; Ashot Sargsyan, Wyle Integrated Science and Engineering; Ashot Sargsyan, Wyle Integrated Science and Engineering; Ashot Sargsyan, Wyle Integrated Science and Engineering; Inavid Amponsah, Henry Ford Hospital; Duglas Ibert, Wyle Integrated Science and Engineering; Ioavid Amponsah, Henry Ford Hospital; Duglas Ibert, Wyle Integrated Science and Engineering; CMOS), Ground Support Biomedical Engineering; (BME) support, flight surgeons and local expert consultants. Expanded diagnostic use of ultrasound is being substantiated for the diagnosis of provide just-in-internating of novice users by creating multi-meed for eraw the halt and performance risks associated with musculoskcletal injuries. Stabie in Lov Earth Orbit (LEO) and future exploration-class missions. Successful completion of this proposal will provide and the string of antive associated with musculoskcletal injuries. Stabie in Lov Earth Orbit (LEO) and future exploration-class missions. Successful completion of this proposal will provide solid data to mission planners and system developers on important operational aspects of in-flight trauma managemen The schedule for this ground based proposal is alsown below: July 2009: Interim Analysis Clinical Trials of Expert users May 2009: Interim Analysis Clinical Tr	Rationale for HRP Directed Research	:		
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injuries which may occur during LEO or exploration class spaceflight. Newer technologies such as volumetric or 3D ultrasound may provide additional precision for complex fractures or for operators without access to just in time training programs, however, these theoretic benefits have not been substantiated to date. Additional trials of 3D ultrasound in musculoskeletal trauma could be included in the subsequent funding year, however, this would impact the timeline and cost of this proposal. The interim analysis concluded that 2D ultrasound provides acceptable sensitivity and specificity for the diagnosis of musculoskeletal trauma and that 3D or volumetric ultrasound is not necessary at this time.

PROGRESS:

Task Progress:

We have screened approximately 720 patients for enrollment into the Fracture Study in the emergency room at Henry Ford Hospital. Initial patient screening was done by Trauma Surgery or Emergency Medicine staff based on mechanism of injury, history, and presenting signs and symptoms suggestive of significant musculoskeletal injury. Informed consent was obtained and a localized ultrasound examination was completed prior to radiographic evaluation by MSK experts or minimally trained personnel using a 10.5 MHz linear probe. The ultrasound examination was initially done on the contra lateral, non-injured side to obtain a reference image and to optimize visualization and focal zone. The entire length of the bone was visualized with special attention to the injured area. A positive scan consisted of identification of cortical disruption or discontinuity. Secondary hematomas and muscular injury were also recorded. Routine radiographic imaging was then completed for comparison against the ultrasound examination.

Demographic, anatomic, and radiographic information were collected for correlation to the ultrasonographic findings. A diagnostic scoring sheet with patient and exam specific data was filled out by the operator immediately following the examination. High fidelity ultrasound images/video loops were also archived for later blinded review. The sensitivity and specificity of the test was determined for the operator and the blinded reviewer. Statistical analysis of the examinations was determined for the operator and the blinded reviews and correlated with radiographic findings by Chi Square analysis with Kappa correction.

The majority (76%) of the patients entered into the study were male with an average age of 38 (range 18-84). The majority of injuries involved falls (72%), followed by motor vehicle accidents (19%) and assaults (7%).

This trial used a blend of expert and non-expert operators to scan the patients with musculoskeletal trauma. The non-expert users received a 1 hour targeted instruction in MSK ultrasound prior to scanning. There was no appreciable difference in examination quality or diagnostic accuracy between expert and novice users in this limited trial (Appendix). The overall sensitivity of ultrasound for the detection of fractures was 96% and the specificity was 99% in this targeted trial. Subgroup analysis shows that the sensitivity is less for fractures in the hand and foot (86%) which is most likely related to the complexity of the examination in this area. There were a limited number of examinations of the femur and hip making statistical analysis impractical, however, observations of this technique suggest that it could be reliable if appropriate attention is given to technical factors including probe selection and depth in larger patients.

We have also evaluated fracture healing in a limited number of patients with hand and rib injuries. Fracture callus formation is readily apparent at 3-4 weeks and the maturation of the bony healing can be followed over a more prolonged period with specific ultrasound findings (Appendix).

Conclusions:

2D ultrasound provides a sensitive and specific point of care examination for long bone MSK injury when performed by expert and non-expert operators. Additional information is necessary to determine the accuracy of the test for fractures in complex areas (wrist, foot) or the potential benefit of 3D ultrasound technologies.

NEXT STEPS:

This trial was done by experts and non-experts in a limited population of patients with MSK injury. We would like to continue to accrue patients in the subsets with small numbers to provide a more robust analysis and to begin work on Specific Aim II to develop a multi-media, point of care training program which would be suitable for NASA Space Medicine user groups and for Crew Medical Officers.

SPECIFIC AIM 2: Develop robust, point-of-care training programs to facilitate the performance of skeletal ultrasound by non-physician CMOs to exclude fracture.

NASA DELIVERABLES:

· Computer based, CMO training program to perform skeletal ultrasound to diagnose skeletal injury

• Cue card functionality to enhance rapid performance of skeletal ultrasound

Bibliography Type:

Description: (Last Updated: 02/23/2023)