

Challenges of Life Support - Medical Support for Manned Space Exploration (9)  
Challenges of Life Support - Medical Support for Manned Space Exploration (2)

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## NONINVASIVE DIAGNOSIS OF BONE LOSS AND RISK OF FRACTURE AND ACCELERATION OF HEALING USING GUIDED ULTRASOUND TECHNOLOGY

### Abstract

**INTRODUCTION** Advents in quantitative ultrasound (QUS) provide a unique method for evaluating both bone strength and density, particularly under the extreme condition like long-term space mission. The objective of this study has two folds, 1) to develop a portable scanning confocal acoustic navigation (SCAN) QUS system for bone quality assessment; and 2) to test a guided ultrasound in acceleration of fracture healing in a disuse fracture (HLS) model. **METHODS** Bone Quality Measurement: A refined QUS imaging system was developed using an array scan mode and portable table scanner design[1,2]. The SCAN was fit into a portable size of approximately two shoe boxes size. QUS was processed to calculate the ultrasound attenuation (ATT; dB), wave ultrasound velocity (UV), and the broadband ultrasound attenuation (BUA; dB/MHz). **Ultrasound Therapy for Fracture Healing:** Total of 36, 5-month old Sprague-Dawley rats were divided into six groups including 1) fracture control (FC, n=12), 2) fracture with HLS (FS, n=12), and 3) fracture with HLS, plus QUS treatment (FSU, n=12). To simulate a microgravity condition, standard fractures were performed at the middle of left femur of each animal with HLS. Guided QUS was delivered transversally at the femur, 20 min/day, 5 days/wk for 5 weeks. Hindlimb bones were longitudinally imaged using CT at week-1,3, and 5. **RESULTS** The SCAN image is able to identify the region of interests even in the bone under 3mm in diameter of the cross section. Longitudinal monitoring of bone mass indicated that, in week 5, BVF in fracture with HLS (0.190.05) showed -6**DISCUSSION** In vivo assessment of bone quality using SCAN predicts overall BMD distributions in the region of interests, and capable to identify fracture. The disuse hind limb suspension indeed delayed the healing, e.g., in 5 weeks. This delay is predicted to extend to the remodeling phase. Guided ultrasound treatment develops the best callus mineralization quality, which is over 48