Bone loss prevention experiment on the last space shuttle flight

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Researchers in the University of North Carolina at Chapel Hill/North Carolina State University Joint Department of Biomedical Engineering will be at the Kennedy Space Center for the last space shuttle launch of the NASA program as Atlantis departs for its final mission into Earth's orbit.

With July 8, 2011 as the target launch date, the UNC/NCSU team led by Ted Bateman, PhD, associate professor in the department, have painstakingly prepared an experiment aboard Atlantis aimed at revealing strategies to protect future astronauts from bone loss during extended exposure to micro-gravity.

Not only is this a milestone in the history of space exploration, but also for Bateman who, along with his collaborators at the BioServe Space Technologies Center with the University of Colorado, has been involved as an investigator in numerous spaceflight studies. Once again he and his team have another research project on this, the final mission of STS-135.

In addition to the human crew of this historic 12-day flight, Atlantis will be host to thirty of its smallest passengers – mice that might help humans one day travel far beyond the moon. These mice are integral to Bateman's research on bone and muscle health in microgravity.

Rapid bone loss, an accelerated osteoporosis, results from removing gravitational loading. Such exposure will be unavoidable for

interplanetary missions such as a round-trip to Mars, explains Bateman. "We've known for quite a while, since the 1970s and the Skylab missions, that astronauts are going to lose bone on these extended missions," Bateman says. "Comprehensive work has been done to identify the amount of loss – about one to two percent per month, which is approximately five times the rate that postmenopausal women lose bone here on Earth.

"And we know that this will cause a decline in bone strength of approximately three percent per month. When astronauts return, the recovery is incomplete. On extended missions, beyond six months up to three years, such as on a Mars mission, this loss is going to be substantial."

Along with his UNC/NCSU team, Bateman's project includes colleagues at the University of Colorado and Harvard University. The study will explore how weightlessness in space affects mouse bone tissue at the molecular level, studying the changes in protein expression by load-sensing bone cells called osteocytes.

Osteocytes are the bone cells primarily responsible for communicating changes in forces and loads to other cells that affect bone mass and strength. Normally, these cells send a signal in the form of a protein called sclerostin to control bone formation.

"Though it has never been tested, we expect that during spaceflight, with the removal of gravitational loading, sclerostin levels will increase significantly," Bateman said. "We believe this increase in sclerostin signal may be a primary reason why bone formation is reduced in astronauts and mice when they are in microgravity."

In this experiment, half of the space-flown mice will be treated with a novel agent that blocks the activity of sclerostin. This experimental

agent, a sclerostin antibody, has been shown to increase bone formation and bone mineral density in ground-based mouse studies. A different sclerostin antibody than the one being used for this space shuttle mouse study is currently in clinical trials as a collaboration between the biopharma companies Amgen Inc. and UCB.

The UNC scientist says that the sclerostin clinical candidate antibody "may offer a potential treatment for Earth-based osteoporosis as a novel way to increase bone formation and prevent fractures."

After the flight, the researchers will analyze the skeletons of the mice for changes in bone strength and bone mineral density, in addition to looking for alterations in bone cell activity and in the biochemical communications used by these cells.

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