

Space-related radiation research could help reduce fractures in cancer survivors

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A research project looking for ways to reduce bone loss in astronauts may yield methods of improving the bone health of cancer patients undergoing radiation treatment.

It is well documented that living in the microgravity environment of space causes bone loss in astronauts, but until recently, little was known about the effects of space radiation on bones. Dr. Ted Bateman leads a project funded by the National Space Biomedical Research Institute (NSBRI) to understand radiation-induced bone loss and to determine which treatments can be used to reduce that loss and lower the risk of fractures.

"Our studies indicate significant bone loss at the radiation levels astronauts will experience during long missions to the moon or Mars," said Bateman, a member of NSBRI's Musculoskeletal Alterations Team.

Bateman, an associate professor of bioengineering at Clemson University, and colleagues at Clemson and Loma Linda University have discovered in experiments with mice that bone loss begins within days of [radiation exposure](#) through activation of bone-reducing cells called osteoclasts. Under normal conditions, these cells work with bone-building cells, called osteoblasts, to maintain bone health.

"Our research challenges some conventional thought by saying radiation turns on the bone-eating osteoclasts," Bateman said. "If that is indeed the case, existing treatments, such as bisphosphonates, may be able to

prevent this early loss of bone."

Bisphosphonates are used to prevent loss of bone mass in patients who have osteoporosis or other bone disorders.

Even though the research is being performed to protect the health of NASA astronauts, [cancer](#) patients, especially those who receive [radiation therapy](#) in the pelvic region, could benefit from the research.

"We know that older women receiving radiotherapy to treat pelvic tumors are particularly vulnerable to fracture, with [hip fracture](#) rates increasing 65 percent to 200 percent in these cancer patients," said Bateman. "Hip fractures are very serious; nearly one in four patients who fracture a hip will not survive a year. A large number of surviving patients will require long-term care. More than 80 percent of the patients will not be able to walk unaided or will not be back to pre-fracture activity levels after a year."

Once a person loses bone, their long-term fracture risk depends on their ability to recover lost bone mass. For older cancer patients, early introduction of [bisphosphonates](#) and other forms of treatment could help greatly since the process of regaining bone mass can be more difficult due to lower activity levels.

Clemson's Dr. Jeff Willey is a collaborator with Bateman and the lead investigator of an NSBRI-funded project looking at the cellular mechanisms involved in radiation-induced bone loss. He said the bone loss in the spaceflight-related experiments has occurred quickly and cell physiology has changed.

"If we expose mice to a relatively low dose of radiation, the cells that break down bone are turned on several days after exposure," he said. "After radiation exposure, osteoclasts appear to have a different shape.

They get flatter, and there are certainly more of them."

The mice used in the research have received the amount of radiation exposure that is expected to occur during a lengthy mission to the moon or Mars. The amount is much less than what cancer patients receive during treatment. For example, patients receiving radiation treatment in the pelvic region can receive doses up to 80 gray over a six- to eight-week period, with the hip receiving up to 25 gray. Astronauts are likely to receive about 0.5 to 1 gray during a long-duration lunar or martian mission.

Astronauts are at risk of radiation exposure from two sources. The first is proton radiation from the sun. The second, and less understood type, is galactic cosmic radiation from sources outside the galaxy. Galactic cosmic rays and protons would be the source of radiation damage for astronauts during a mission to Mars.

Marcelo Vazquez, NSBRI's senior scientist for space radiation research, said Bateman's project and other NSBRI radiation projects will influence spacecraft design and mission planning. "The research will help to define the [radiation](#) risks for astronauts during long-term missions," Vazquez said. "This will lead to strategies for shielding and medical countermeasures to protect against exposure."

Bateman's NSBRI work is leading to other studies. "We have been able to initiate a couple of clinical trials with cancer patients to determine if what we are seeing in mice corresponds with [bone loss](#) in humans. Preliminary results in these trials show rapid declines in bone mass and strength," Bateman said.

Source: National Space Biomedical Research Institute

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