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Researchers Growing Bone in a Lab

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As the nation ages, an estimated 44 million Americans, including at least half of those ages 50 and older, are at risk for osteoporosis, making their bones fragile and vulnerable to serious fractures.

Now, a Florida State University engineering professor is looking to develop new technologies that could replace bone mass lost to the disease, as well as treat traumatic bone injuries such as those suffered in automobile accidents or combat. Teng Ma, an associate professor of chemical and biomedical engineering at the Florida A&M University-FSU College of Engineering, and two colleagues have received an $824,000, four-year grant from the U.S. Department of Defense to research ways of generating bone cells in a laboratory that then could be transplanted into human patients.

"The Department of Defense's main interest in this research is its potential for developing new treatments and therapies for military personnel who have suffered bone loss due to diseases or traumatic injuries," Ma said. "However, many other types of patients who suffer from bone diseases could benefit from this research as well."

Ma pointed to recent students showing that tissue-engineered bone grafts are effective for correcting bone defects resulting from osteoporosis and other bone-related diseases. One out of every two women and one in four men over the age of 50 eventually will suffer an osteoporosis-related fracture, and many more are at risk. Such fractures typically occur in the hip, spine and wrist.

"Currently, there are two sources of bone that can be used for performing corrective grafts - the patient's own body and human cadavers," Ma said. "Both of these have severe limitations. There is a limited supply, obviously, of bone tissue that can be taken from one part of the patient's body to be grafted onto another. And with cadaveric bone" - bone taken from human cadavers - "immune response and the possibility of viral infection remain a concern."

Ma's research involves growing human mesenchymal, or adult, stem cells in a laboratory using a device he has patented known as a perfusion bioreactor. Each stem cell has the ability to divide so as to produce a perfect copy of itself; the copy then can become a "workhorse" cell, such as a bone or nerve cell. By subjecting the stem cells to very specific conditions that mimic those they would encounter in the human body, he seeks to determine what type of cell they turn into - in this case, bone. The bone cells then would be combined with a biomaterial to create tissue similar in structure and density to that of actual bone.

"Artificial bone grafts generated by combining a patient's own stem cells with biomaterials represent a novel approach that overcomes the donor limitation, reduces immune response, and increases the rate of effectiveness for defect repair and healing," Ma said. He cautioned, though, that stem-cell research is a long-term proposition.

"We're not going to see artificially created bone tissue being transplanted into human patients by this time next year," he said. "Stem-cell research still is in its very early stages, and we have a great deal more research to do - and regulatory hurdles to overcome - before this is ready for medical use."

Collaborating with Ma on the Department of Defense research are Bruce Bunnell, an associate professor of pharmacology at Tulane University; and Feng Zhao, a postdoctoral researcher at the FAMU-FSU College of

Engineering.

To read more about recent stem-cell research conducted by Ma, see www.fsu.com/pages/2005/11/10/StemCell.html .

Source: Florida State University