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Contact: Les Lang
llang@med.unc.edu
919-966-9366
University of North Carolina School of Medicine

Stem cell treatment may offer option for broken bones that don't heal

(Embargoed) CHAPEL HILL, N.C. – Researchers at the University of North Carolina at Chapel Hill School of Medicine have shown in an animal study that transplantation of adult stem cells enriched with a bone-regenerating hormone can help mend bone fractures that are not healing properly.

The UNC study team led by Anna Spagnoli, MD, associate professor of pediatrics and biomedical engineering, demonstrated that stem cells manufactured with the regenerative hormone insulin-like growth factor (IGF-I) become bone cells and also help the cells within broken bones repair the fracture, thereby speeding the healing. The new findings are presented Sunday, June 5, 2011 at The Endocrine Society's 93rd Annual Meeting in Boston, Massachusetts.

A deficiency of fracture healing is a common problem affecting an estimated 600,000 people annually in North America. "This problem is even more serious in children with osteogenesis imperfecta, or brittle bone disease, and in elderly adults with osteoporosis, because their fragile bones can easily and repeatedly break, and bone graft surgical treatment is often not successful or feasible," Spagnoli said.

Approximately 7.9 million bone fractures occur every year in the United States alone, with an estimated cost of $70 billion. Of these, 10 to 20 percent fail to heal.

Fractures that do not mend within the normal timeframe are called non-union fractures. Using an animal model of a non-union fracture, a "knockout" mouse that lacks the ability to heal broken bones, Spagnoli and her colleagues studied the effects of transplanting adult stem cells enriched with IGF-I. They took mesenchymal stem cells (adult stem cells from bone marrow) of mice and engineered the cells to express IGF-I. Then they transplanted the treated cells into knockout mice with a fracture of the tibia, the long bone of the leg.

Using computed tomography (CT) scanning, the researchers showed that the treated mice had better fracture healing than did mice either left untreated or treated only with stem cells. Compared with controls left to heal on their own or recipients of stem cells only, treated mice had more bone bridging the fracture gap, and the new bone was three to four times stronger, according to Spagnoli.

"More excitingly, we found that stem cells empowered with IGF-I restored the formation of new bone in a mouse lacking the ability to repair broken bones. This is the

first evidence that stem cell therapy can address a deficiency of fracture repair," she said.

This success in an animal model of fracture non-union, Spagnoli said, "is a crucial step toward developing a stem cell-based treatment for patients with fracture non-unions."

"We envision a clinical use of combined mesenchymal stem cells and IGF-1 similar to the approach employed in bone marrow transplant, in which stem cell therapy is combined with growth factors to restore blood cells," she said. "I think this treatment will be feasible to start testing in patients in a few years." IGF-I is currently approved for treatment of children with a deficiency of this hormone, causing growth failure.

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Others that contributed to the research are: Froilan Granero-Molto, Timothy Myers, Jared Weis, Lara Longobardi, Tieshi Li, Yun Yan, Natasha Case, and Janet Rubin.

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