Building bone from cartilage

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A person has a tumor removed from her femur. A soldier is struck by an improvised explosive device and loses a portion of his tibia. A child undergoes chemotherapy for osteosarcoma but part of the bone dies as a result.

Every year, millions of Americans sustain fractures that don't heal or lose bone that isn't successfully grafted. But a study presented at the Orthopaedic Research Society (ORS) 2012 Annual Meeting in San Francisco offers new hope for those who sustain these traumas.

Orthopaedic researchers with the University of California, San Francisco (UCSF), Orthopaedic Trauma Institute, have found a very promising, novel way to regenerate bone. "Cartilage graft induces bone that actually integrates with the host bone and vascularizes it," said Ralph S. Marcucio, PhD, Associate Professor, UCSF School of Medicine.

Cartilage graft is very different than the current methods used for bone grafting—autograft bone (a person's own bone) or allograft materials (donor bone). For various reasons, these two grafting techniques can result in poor graft integration and osteonecrosis.

"With millions of bone grafting procedures performed every year in just the United States, developing improved technologies could directly enhance patient care and clinical outcomes," Dr. Marcucio said.

Chelsea S. Bahney, PhD, Postdoctoral Scholar, UCSF School of Medicine, concedes their approach is less orthodox. "It is not the

pathway that most people think about, but it made a lot more sense to follow the normal developmental mechanism."

"This cartilage is naturally bioactive. It makes factors that help induce vascularization and bone formation," added Dr. Bahney. "When people use a bone graft, it is often dead bone which requires something exogenous to be added to it or some property of the matrix in the graft."

Through a process called endochondral ossification, cartilage grafts produce new tissue that is very similar to the person's own bone. Without additional properties to it, the researchers found the cartilage graft integrated well and was fully vascularized.

"We're just taking a very similar cartilage that can induce bone formation, putting it into a bone defect and letting it just do its thing," Dr. Marcucio said.

In the study, the researchers chose a non-stabilized tibial fracture callus as a source of a cartilage graft. "Healing of the transplanted cartilage grafts supported our hypothesis by producing a well-vascularized bone that integrated well with the host," Dr. Bahney said.

"A cartilage graft could offer a promising alternative approach for stimulating bone regeneration," Dr. Marcucio said. "Future work will focus on developing a translatable technology suitable for repairing bone through a cartilage intermediate at a clinical level."

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