Medical Xpress

It's all in the wrapping: Mimicking periosteum to heal traumatic bone injury

December 13 2011

A manmade package filled with nature's bone-building ingredients delivers the goods over time and space to heal serious bone injuries faster than products currently available, Cleveland researchers have found.

Tested on sheep in Switzerland, the surgical elastic "implant device," essentially a wrapping that mimics bone's own sock-like sheath called periosteum, delivered stem cells, growth factors and other natural components of the periosteum to heal a defect that would not heal on its own if left untreated. In experimental groups exhibiting best outcomes, a dense network of new bone filled the defect, from the surgical elastic wrapping on the outside towards the steel intramedullary nail that stabilized the bone on the inside, bridging old with new bone.

Melissa Knothe Tate, a joint professor of biomedical engineering and mechanical & aerospace engineering at Case Western Reserve University; Ulf Knothe, an orthopedic surgeon at the Cleveland Clinic, as well as Hana Chang and Shannon Moore, graduate students in Knothe Tate's lab, report their work in today's issue of *PLoS ONE*.

"We're trying to use the methods Mother Nature uses to generate bone," Knothe Tate said.

The device is modeled after the periosteum, the sock-like covering of bone, which is filled with stem cells and growth factors that, given the right cues, grow bone. Knothe Tate and her husband, Knothe, reported

last year that bridging a bone injury with periosteum healed bone faster than any currently used methods, in testing on sheep and in limited clinical cases.

But, often there is too little of the periosteal covering left to fully cover the gap after a traumatic injury.

Based on what they'd learned, Knothe Tate built a version of periosteum out of two elastic sheets, approved by the FDA for surgery. She left one intact and perforated the other in a gradient with most holes across the center of the sheet and fewer the farther from the center.

She sewed the sheets together using surgical sutures as thread, with the perforated sheet on the inside. The suture seams create a series of pockets, left open at what would be the top and bottom of the device. The device is sutured to the healthy tissue like a patch and provides a path for movement of cells and bone building materials upward, downwards and inwards.

The researchers filled the pockets of one set of the devices with membranes made of collagen, which is a natural component of the periosteum; a second set was filled with collagen membranes seeded with cells that reside in the periosteum , and a third set with strips of periosteum. Both the collagen seeded sheets and the periosteum strips tucked into the pockets showed the most promising results for bridging of critical sized defects that do not heal on their own.

The pockets filled with natural periosteal strips, although no longer connected to a blood supply, provided the ingredients to grow bone quickly, densely, and completely in a group of five adult sheep, Knothe Tate said.

In addition to providing the ingredients at the right place and time, the

device, along with the nail, act as a template for the new growth.

"This really blurs the line between an implant and a delivery system," Knothe Tate said.

Depending on how she directs growth, the device can grow bone two ways found in nature. Much of the skeleton forms as cartilage first then turns to bone before birth, while the skull grows directly from stem cells into bone.

Beyond bone, the device is flexible enough to be used in a broad array of applications, Knothe Tate said. Potential uses include growing cartilage for orthopedics, to fuse vertebrae, as a delivery system for stem cells, antibiotics, transcription factors and more.

Provided by Case Western Reserve University

Citation: It's all in the wrapping: Mimicking periosteum to heal traumatic bone injury (2011, December 13) retrieved 20 September 2024 from https://medicalxpress.com/news/2011-12-mimicking-periosteum-traumatic-bone-injury.html