Orthopedics
Augmentation of degenerated human cartilage.


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Abstract
PURPOSE: The purpose of this study was to investigate whether it is possible to regenerate degenerated human cartilage in vitro by use of magnetically labeled mesenchymal stem cells (MSCs) and an external magnetic device.

METHODS: MSCs from human bone marrow were cultured and magnetically labeled. Degenerated human cartilage was obtained during total knee arthroplasty. The osteochondral fragments were attached to the sidewall of tissue culture flasks, and magnetically labeled MSCs were injected into the flasks. By use of an external magnetic device, a magnetic force was applied for 6 hours to the direction of the cartilage, and then the degenerated cartilage was cultured in chondrogenic differentiation medium for 3 weeks. In the control group a magnetic force was not applied. The specimens were evaluated histologically.

RESULTS: A cell layer was formed on the degenerated cartilage as shown by H&E staining. The cell layer was also stained in toluidine blue and safranin O and with anticollagen type II immunostaining, indicating that the cell layer contained an extracellular matrix. In the control group a cell layer was not observed on the cartilage.

CONCLUSIONS: We were able to show that our system could deliver MSCs onto degenerated human cartilage and then form an extracellular matrix on the degenerated cartilage in vitro.

CLINICAL RELEVANCE: Our novel cell delivery system using magnetic force may lead toward a new treatment option for osteoarthritis.

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Promising stem cell therapy may prevent osteoarthritis after joint injury

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Duke researchers may have found a promising stem cell therapy for preventing osteoarthritis after a joint injury.

Injuring a joint greatly raises the odds of getting a form of osteoarthritis called post-traumatic arthritis, or PTA. There are no therapies yet that modify or slow the progression of arthritis after injury.

Researchers at Duke University Health System have found a very promising therapeutic approach to PTA using a type of stem cell, called mesenchymal stem cells (MSCs), in mice with fractures that typically would lead to them developing arthritis. Their findings could lead to a therapy that would be used after joint injury and before signs of significant osteoarthritis.

"The stem cells were able to prevent post-traumatic arthritis," said Farshid Guilak, Ph.D., director of orthopaedic research at Duke and senior author of the study.

The study was published on August 10 in Cell Transplantation.

The researchers also thought that a type of mice bred for their super-healing properties would probably fare better than typical mice, but they were wrong.

"We decided to investigate two therapies for the study, said lead author Brian Diekman, Ph.D., a postdoctoral researcher in the Guilak lab. "We thought that stem cells from so-called superhealer mice would be superior at providing protection, and instead, we found that they were no better than stem cells from typical mice. We thought that maybe it would take stem cells from superhealers to gain an effect as strong as preventing arthritis after a fracture, but we were surprised - and excited - to learn that regular stem cells work just as well."

Certain people appear to fall into the superhealer category, too. They bounce back quickly and heal well naturally after a fracture, while other people eventually form cases of arthritis at the fractured joint, said Guilak, who is a professor of orthopaedic surgery and biomedical engineering.

"The ability of the superhealer mice to have superior healing after a fracture may go beyond the properties of their stem cells and be some beneficial factor, like a growth factor, that we don't know about yet," Guilak said.

The delivery of 10,000 typical or superhealer stem cells to the joint prevented the mice from developing PTA, unlike a control group that received only saline.

Diekman said the team looked at markers of inflammation and saw that the stem cells affected the inflammatory environment of the joint after fracture.

"The stem cells changed the levels of certain immune factors, called cytokines, and altered the bone healing response," said Diekman, who is also with the Duke Department of Biomedical Engineering.

Guilak said that very few studies have purified stem cells to the degree they were purified for this study. They used mesenchymal stem cells, which are bone marrow cells not destined to become part of blood.

Diekman said that one of the challenges in the field is isolating and developing a system for sorting the specific cells they wanted, the mesenchymal stem cells, which form a very rare cell type in the bone marrow.

"We found that by placing the stem cells into low-oxygen conditions, they would grow more rapidly in culture so that we could deliver enough of them to make a difference therapeutically," Diekman said.

Source: Duke University Medical Center
