Medical Xpress

Hope for arthritis patients in fat tissue

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John A. Szivek

(PhysOrg.com) -- A recent discovery at the University of Arizona College of Medicine -- that adult stem cells collected from fat tissue can be converted to cells that will grow cartilage tissue -- has focused one Arizona Arthritis Center lab's research, promising new hope for osteoarthritis sufferers.

John A. Szivek, director of the UA Orthopaedic Research Laboratory and a senior scientist at the UA's Arizona Arthritis Center, is widely recognized for his studies on bone and cartilage regeneration with the goal of repairing damaged joints. In recent years, he and his team have focused on the complex problem of re-growing hyaline articular cartilage - the cartilage that covers the surface of bone in all our joints.

Szivek is a professor in the UA department of orthopaedic surgery and the Interdisciplinary Biomedical Engineering Program. In addition, he is a member of the BIO5 Institute at the UA and a member of the departments of aerospace and mechanical engineering and of materials science. He also holds the William and Sylvia Rubin Endowed Chair of Orthopaedic Research.

Until recently, his procedure for studying and growing new cartilage tissue involved removing a small piece of cartilage from the joint to be repaired, extracting cells in the lab, and growing the new tissue on a scaffold, which then was implanted into the joint. Because of the complexity of hyaline cartilage tissue, comprised of several layers of cells that do not divide or reproduce readily, the process was painstakingly slow and unpredictable, and new tissue often did not form at all.

Four years ago, however, Szivek's team discovered that it could grow cartilage from differentiated (converted) adult stem cells extracted from fat tissue.

These cells offer numerous advantages over cartilage cells. Not only can they be changed readily into a range of other cell types, but because of their long, spindly shape - unlike the rounded shapes of cartilage cells - researchers easily can judge whether they are aligning into the highly structured form they must be in to build hyaline cartilage. These cells are abundant and easier to obtain than cartilage cells and, since they are derived from a patient's own fat tissue, they ensure there is no risk for rejection once they are introduced into the patient.

While earlier work in the Szivek lab concentrated on repairing damage to a relatively small area of a joint, the ability to grow cartilage more quickly and easily will make it possible to resurface a larger area of a damaged joint and, as such, will offer an alternative to total joint replacement.

"Although a person's knee is composed of three distinct surfaces, the inside (medial), outside (lateral) and the knee cap interfacing surface, many times only one surface of the joint is damaged," Szivek said, "but the only successful treatment we have at the moment replaces the whole joint."

Typically, joint replacements are metal or ceramic and plastic parts, he explains. With the new procedure, patients will retain their own intact joint surfaces, and damaged surfaces will be regenerated with new cartilage grown from their own fat-tissue derived stem cells.

"We potentially are curing a problem rather than just treating the symptoms," he added.

Szivek's earlier work involved implanting a small, rounded scaffold engineered by mimicking perfectly the normal structure of the injured bone in the joint.

Before it is implanted, cartilage tissue growth on the surface is started in the lab. On the inside, these scaffolds are porous with a bone-like structure, allowing new bone growth to anchor them in place.

Another novel aspect of Szivek's scaffold system is that it is equipped with tiny sensors and a radio transmitter to monitor the patients' activities and warn them if they risk injury to their new cartilage during exercise.

With his newest approach to growing cartilage, the scaffold covers one entire surface of the joint and makes it possible to grow cartilage over this much larger surface area. This scaffold also accommodates sensors and a transmitter that measure the loads passing through the replaced surface and notify the patient when the joint is overloaded.

The total surface replacement technique currently is being tested in the lab and is showing promise. The next steps include relocating the cell processing procedures to an FDA-approved clean room and preparing to test the procedure with a patient, "possibly within a couple of years," Szivek said.

Provided by University of Arizona