

Stem cell scientists first to track joint cartilage development in humans

December 13 2013, by Shaun Mason

(Medical Xpress)—Stem cell researchers from UCLA have published the first study to identify the origin cells and track the early development of human articular cartilage, providing what could be a new cell source and biological roadmap for therapies to repair cartilage defects and damage from osteoarthritis.

Such transformative therapies could reach clinical trials within three years, said the scientists from UCLA's Eli and Edythe Broad Center of Regenerative Medicine and Stem Cell Research.

The study, led by Dr. Denis Evseenko, an assistant professor of orthopedic surgery and head of UCLA's Laboratory of Connective Tissue Regeneration, was published online Dec. 12 in the journal *Stem Cell Reports* and will appear in a forthcoming print edition.

Articular cartilage, a highly specialized tissue formed from [cells](#) called chondrocytes, protects the bones of joints from forces associated with load-bearing and impact and allows nearly frictionless motion between the articular surfaces—the areas where bone connects with other bones in a joint.

Cartilage injury and a lack of cartilage regeneration often lead to osteoarthritis, which involves the degradation of joints, including cartilage and bone. Osteoarthritis currently affects more than 20 million people in the U.S., making joint-surface restoration a major priority in modern medicine.

While scientists have studied the ability of different cell types to generate [articular cartilage](#), none of the current cell-based repair strategies—including expanded articular chondrocytes or mesenchymal stromal cells from adult bone marrow, adipose tissue, synovium or amniotic fluid—have generated long-lasting articular cartilage tissue in the laboratory.

For the current study, Evseenko and his colleagues used complex molecular biology techniques to determine which cells grown from embryonic [stem cells](#), which can become any cell type in the body, were the progenitors of cartilage cells, or chondrocytes. They then tested and confirmed the growth of these progenitor cells into cartilage cells and monitored their growth progress, observing and recording important genetic features, or landmarks, that indicated the growth stages of these cells as they developed into the cartilage cells.

By bridging developmental biology and tissue engineering, Evseenko's discoveries represent a critical "missing link," providing scientists with checkpoints to tell if the [cartilage cells](#) are developing correctly.

"We began with three questions about cartilage development," Evseenko said. "We wanted to know the key molecular mechanisms, the key cell populations and the developmental stages in humans. We carefully studied how the chondrocytes developed, watching not only their genes but other biological markers that will allow us to apply the system for the improvement of current stem cell-based therapeutic approaches."

The research was also the first to employ the highest animal-free standards in attempting to generate all the key landmarks that allow the development of cell types that could be used in treatments to regrow damaged human cartilage. Stem cells are often grown using animal-based components, which help the stem cells flourish and grow, but such components can lead to unwanted variations and contamination.

Evseenko's research process did not rely on any animal components, thus allowing for the potential production of therapies, such as stem cell serums, that are safe for humans.

Evseenko noted that in a living organism, more than one cell type is responsible for the complete regeneration of tissue, so in addition to the studies involving the generation of articular cartilage from human stem cells, he and his team are trying different protocols using various combinations of adult progenitor cells present in the joint to regenerate cartilage until the best one is found for therapeutic use.

With the [progenitor cells](#) and the landmarks of proper cartilage development identified, Evseenko believes that an effective cellular therapy for diseased or damaged [joint cartilage](#) could be tested in human trials within three years. Such stem cell-based therapies could make many current knee and hip replacement surgeries unnecessary, offering patients the ability to regrow lost [cartilage](#), keep their bones intact and avoid the discomfort and risk of major joint-replacement surgery.

More information: Read the full report: download.cell.com/stem-cell-re ... df?intermediate=true

Provided by University of California, Los Angeles

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