# Embryonic stem cells used to grow cartilage

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Rice University biomedical engineers have developed a new technique for growing cartilage from human embryonic stem cells, a method that could be used to grow replacement cartilage for the surgical repair of knee, jaw, hip, and other joints.

"Because native cartilage is unable to heal itself, researchers have long looked for ways to grow replacement cartilage in the lab that could be used to surgically repair injuries," said lead researcher Kyriacos A. Athanasiou, the Karl F. Hasselmann Professor of Bioengineering. "This research offers a novel approach for producing cartilage-like cells from embryonic stem cells, and it also presents the first method to use such cells to engineer cartilage tissue with significant functional properties."

The results are available online and slated to appear in the September issue of the journal *Stem Cells*. The study involved cells from an NIH-sanctioned stem cell line.

Using a series of stimuli, the researchers developed a method of converting the stem cells into cartilage cells. Building upon this work, the researchers then developed a process for using the cartilage cells to make cartilage tissue. The results show that cartilages can be generated that mimic the different types of cartilage found in the human body, such as hyaline articular cartilage -- the type of cartilage found in all joints -- and fibrocartilage -- a type found in the knee meniscus and the jaw joint. Athanasiou said the results are exciting, as they suggest that similar methods may be used to convert the stem cell-derived cartilage cells into robust cartilage sections that can be of clinical usefulness.

Tissue engineers, like those in Athanasiou's research group, are attempting to unlock the secrets of the human body's regenerative system to find new ways of growing replacement tissues like muscle, skin, bone and cartilage. Athanasiou's Musculoskeletal Bioengineering Laboratory at Rice University specializes in growing cartilage tissues.

The idea behind using stem cells for tissue engineering is that these primordial cells have the ability to become more than one type of cell. In all people, there are many types of "adult" stem cells at work. Adult stem cells can replace the blood, bone, skin and other tissues in the body. Stem cells become specific cells based upon a complex series of chemical and biomechanical cues, signals that scientists are just now starting to understand.

Unlike adult stem cells, which can become only a limited number of cell types, embryonic stem cells can theoretically become any type of cell in the human body.

Athanasiou's group has been one of the most successful in the world at studying cartilage cells and, especially, engineering cartilage tissues. He said that for his research the primary advantage that embryonic stem cells have over adult stem cells is their ability to remain malleable.

"Identifying a readily available cell source has been a major obstacle in cartilage engineering," Athanasiou said. "We know how to convert adult stem cells into cartilage-like cells. The more problematic issue comes in trying to maintain a ready stock of adult stem cells to work with. These cells have a strong tendency to convert from stem cells into a more specific type of cell, so the clock is always ticking when we work with them."

By contrast, Athanasiou said his research group has found it easier to grow and maintain a stock of embryonic stem cells. Nonetheless, he is quick to point out that there is no clear choice about which type of stem cell works best for cartilage engineering.

"We don't know the answer to that," Athanasiou said. "It's extremely important that we study all potential cell candidates, and then compare and contrast those studies to find out which works best and under what conditions. Keep in mind that these processes are very complicated, so it may well be that different types of cells work best in different situations."

Athanasiou began studying embryonic stem cells in 2005. Since funding for the program was limited, he asked two new graduate students in his group if they were interested in pursuing the work as a secondary project to their primary research. Those students, Eugene Koay and Gwen Hoben, are co-authors of the newly published study. Both are enrolled in the Baylor College of Medicine Medical Scientist Training Program, a joint program that allows students to concurrently earn their medical degree from Baylor while undertaking Ph.D. studies at Rice.

"Eugene and Gwen are both outstanding students," Athanasiou said. "Each earned their undergraduate degree from Rice and each worked in my laboratory as undergraduate students. They have chosen to do this research because they think this may represent the future of regenerative medicine."

Source: Rice University

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