Scientists turn stem cells into cells for cartilage repair

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(PhysOrg.com) -- Manchester scientists have turned embryonic stem cells into the cells that produce cartilage, which could be used to repair damaged and diseased joints.

The team, based at The University of Manchester and Central Manchester NHS Foundation Trust, hope this work will lead the way to the use of human embryonic stem cells to provide cheaper and more readily available treatments for joint diseases and that the principles can be developed for other chronic human conditions.

Cartilage damage can be caused by disease or injury and is a major socio-economic and healthcare cost to the country. It is estimated that around 8 million people in the UK have osteoarthritis – the most common form of arthritis, which results in the cartilage becoming damaged at the end of bones, leading to pain, stiffness and loss of mobility – and that about one million of these request specialist treatment, which is limited to pain relief and ultimately leads to joint replacement. Sports injuries involving cartilage damage are also increasingly commonplace with a need for surgical intervention.

The findings are the result of collaboration between the North West Embryonic Stem Cell Centre (NWESCC) and Wellcome Trust Centre for Cell Matrix Research (WTCCMR) with the team including Dr Rachel Oldershaw and Professors Sue Kimber, Tim Hardingham and Daniel Brison.

The researchers, whose findings are published in *Nature Biotechnology* on Sunday 17th October 2010, took human embryonic stem cells – the pluripotent stem cells that can turn into any of the cells that make up the different tissues in our body – and developed a culture procedure involving a precise sequential programme of conditions to specifically produce chondrocytes, the cells that go on to form cartilage. The important aim was to control the stem cells to produce only the types of cells required and this was achieved by programming the cells' development with a timed series of culture conditions containing different added nutrients.

This controlled programme takes only 14 days to generate a high yield of cells. It also establishes a chemically-defined and reproducible process with a format that can be developed for large scale production of these cells.

Professor Kimber, Co-director of NWESCC with Professor Brison, said: "We were very encouraged to have been able to generate chondrocytes within 14 days using a controlled and well defined programme and it now remains for us to take these cells and test their performance to repair cartilage in live animals.

"The big challenge with embryonic stem cells is getting all the cells in a culture to do the same thing together, in order to make specific cells types. This work is a big step towards that. Using the same principles we could adapt the procedure to produce not just chondrocytes, but other types of cells, for different clinical applications.

"To do this so efficiently for directing embryonic stem cells towards chondrocytes was a great result."

Professor Hardingham, of the WTCCMR, said: "Current cell treatment for cartilage repair has some success, but involves two surgical operations as it takes tissue from the patient to derive the cells. It is generally best suited to sports injury in younger healthy patients and is relatively expensive. The use of these stem cell derived chondrocytes may lead to simpler surgical procedures and it raises the possibility of using one source of banked cells for many patients with inherent reduced costs.

"Our work could therefore lead to a treatment for cartilage repair that is both easier and cheaper and may be extended to early osteoarthritic patients, but this will take a considerable amount of time for further development."

The team at NWESCC, a University collaboration with the Central Manchester NHS Foundation Trust and funded by awards to Professor Brison and Professor Kimber from NW Science Fund and MRC, now plan with new funds from Arthritis Research UK to grow and transplant cartilage tissue to live animals to test the potential for cartilage repair. They will go on to investigate generating chondrocytes and other cells from embryonic stem cells that are suitable for clinical use and are produced under clinically relevant stringent conditions. They believe it will take up to ten years to produce a treatment for general human clinical use.

More information: 'The directed differentiation of human embryonic stem cells towards chondrocytes', *Nature Biotechnology*, Sunday 17th October 2010.

Provided by University of Manchester