Embryo growth gene offers key to stem cell and IVF revolution

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Scientists in Britain have snipped a "master gene" out of human embryos in an experiment that could lead to better fertility treatments and galvanise stem cell medicine.

It is the first time that researchers have carried out this pioneering procedure to reach a deeper understanding of the earliest stages of human life. The work raises the prospect of significant improvements in IVF success rates.

In the long run, however, its greatest benefit is likely to be a way of sending adult cells back to an early stage of development that allows them to repair damage to any part of the body.

This would help biologists to discover new drugs and to combat a wide range of illnesses with a kind of super stem cell derived from the patient's own skin.

The study, published in the journal *Nature*, reveals the role that genes play over the first seven days of an embryo's existence, as it produces a small pouch of cells that can turn into anything from neurons to kneecaps.

A group led by Kathy Niakan at the Francis Crick Institute in London cut a gene known as OCT4 out of 41 surplus embryos donated by patients at a Cambridge IVF clinic. Without this gene, the embryos were unable to grow properly after four or five days. Crucially, the gene also appears to keep embryonic stem cells stuck in a youthful form that preserves their ability to "differentiate" into other kinds of cell. This means that mastering OCT4 will be key to making better stem cells for medical use.

"We study the role of genes in human development because we want to understand our own biology," Dr Niakan said. "It has clinical importance. This knowledge gained from understanding the role of OCT4 and other genes will in turn lead to improvements in stem cell biology, and it could lead to potential improvements in IVF treatment."

The approach could yield new formulas for IVF petri dishes that coax OCT4 and other genes into performing as they should. For reasons that remain mysterious, fewer than a quarter of the embryos created with current techniques result in pregnancy.

The study could also revolutionise stem cell science. Researchers have been exploring ways of turning ordinary adult cells into "induced pluripotent" stem (iPS) cells, capable of becoming any kind of tissue, since a Japanese breakthrough in 2006.

Although these cells have shown great promise for reversing the degeneration that plays a central role in many of humanity's most costly and common diseases, there are concerns about their safety and suitability.

In some experiments, iPS cells have shown a tendency to produce cancers after they were injected into mice, according to James Turner, another Crick Institute scientist who worked on the research.

The British study shows that controlling OCT4 and the other genes involved in this process could create stem cells that can generate body parts as rapidly and reliably as they do in an early embryo.

This would involve tweaking the ingredients in the petri dish to recreate something much like the first few days of an embryo.

The resulting stem cells could either be used in laboratory tests to identify new drugs or transplanted into damaged tissue, such as the brains of dementia patients or the joints of people with arthritis.

Dr Taylor said: "We have the technology to create and use pluripotent stem cells, which is undoubtedly a fantastic achievement, but we still don't understand exactly how these cells work. Learning more about how different genes cause cells to become and remain pluripotent will help us to produce and use stem cells more reliably."

Creating the super stem cell

Removing the OCT4 "master gene" from DNA shows the embryo cannot grow normally without it