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Within Discredited Stem Cell Research, a True Scientific First

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The world of stem cell research was set reeling two years ago when its most successful practitioner, the Korean scientist Hwang Woo Suk, was found to have fabricated much of his work. But according to a new post-mortem of his research, he did achieve a scientific first, though not the one he claimed.

Dr. Hwang said he had derived embryonic stem cells from the adult cells of a patient, but the claim was discredited after parts of his research were found to have been faked. A team of Boston scientists has now re-examined stocks of Dr. Hwang's purported embryonic stem cells and arrived at a surprising conclusion: His embryonic stem cells were the product of parthenogenesis, or virgin birth, meaning they were derived from an unfertilized egg.

A team led by Kitai Kim and George Q. Daley of Children's Hospital Boston reports this conclusion today in the journal *Cell Stem Cell*.

Embryonic stem cells derived through parthenogenesis cannot develop normally, so they are free of ethical objections. The cells could perhaps help treat degenerative diseases in women capable of supplying eggs, should effective treatments ever be developed.

Other researchers have since developed embryonic stem cells from parthenogenetic eggs, but Dr. Hwang's team would have been the first to do so had its members recognized what they had done.

"It could have been a seminal finding if they hadn't had their blinders on," said Kent E. Vrana, an expert on parthenogenesis at Pennsylvania State University.

John D. Gearhart, a stem cell expert at Johns Hopkins University who had a ringside view of the Hwang affair as a member of the journal *Science*'s advisory board, said parthenogenesis had always been a possibility.

"I'm delighted there was an explanation that didn't involve fraud," Dr. Gearhart said.

Dr. Hwang soared to prominence after asserting in a report in *Science* in 2004 that he had developed embryonic stem cells from a patient, the first hurdle in the idea of rebuilding patients' tissues with their own cells.

He said he had removed the nucleus from an unfertilized human egg and inserted a new nucleus from the adult cell of the patient. The egg developed into an embryo, from which his team claimed to have developed embryonic stem cells.

The editors of *Science*, the journal that published his claim, later retracted the article because the Korean committee that investigated Dr. Hwang's work found that the supporting data had been faked.

As to the source of Dr. Hwang's embryonic stem cells, the Korean committee said parthenogenesis was possible. But this could not be proved with the methods then available.

Dr. Daley has been studying parthenogenesis in mice with new devices that can analyze DNA at up to 500,000 sites on the genome. Recognizing that parthenogenetic cells have a special and unexpected genetic signature, Dr. Daley realized he could resolve the origin of Dr. Hwang's cells.

"It becomes an historic irony that Hwang was the first to produce the parthenogenetic stem cell but didn't appreciate what he had," Dr. Daley said.

Although some creatures can reproduce by parthenogenesis, virgin birth would be a miracle in humans because the chromosomes from the mother and father each carry special chemical imprints, and both are required for normal development. Parthenogenetic embryos, in which both sets of chromosomes carry a female imprint, are not viable.

But Dr. Daley said that a case is known of a male patient who is a parthenochimera ("chimera" meaning an individual who is composed of two different types of cell). Two embryos, one normal and one parthenogenetic, fused in the womb. Some of the patient's cells have the X and Y chromosomes of a normal man, but his blood has the two X chromosomes of parthenogenetic cells, evidently an instance of semi-virgin birth.

Dr. Hwang seems unlikely to get much scientific credit for developing embryonic cells via parthenogenesis because he said in his 2004 article that he had done tests showing that parthenogenesis was unlikely. He also said he had removed the nucleus from every egg, which he could not have done in the case of the egg that developed parthenogenetically.