

## Q & A: Oregon National Primate Research Center Gene Therapy Breakthrough



Mito and Tracker



Shoukhrat Mitalipov, Ph.D.

### **Q: What did OHSU's Oregon National Primate Research Center accomplish?**

A: In short, scientists at the Oregon National Primate Research Center, led by Shoukhrat Mitalipov, Ph.D., have created a new method of gene therapy geared toward preventing serious diseases that are passed from mothers to their children. More precisely, the research team was specifically looking for a way to prevent inherited diseases that are carried in a mother's cell mitochondria from being passed on to future generations. To date, no such method exists.

### **Q: What is the significance of this discovery?**

A: This discovery is considered a major breakthrough due to the prevalence of diseases caused by gene mutations in cell mitochondria. There are 150 known diseases caused by mutations of the mitochondrial DNA, and approximately 1 out of every 200 children is born with mitochondrial gene mutations.

### **Q: What specific diseases are caused by mutated genes in cell mitochondria?**

A: Certain forms of cancer can be caused by mutations in the genes of cell mitochondria. Other diseases that can be caused by these mutations are diabetes, infertility, myopathies and neurodegenerative diseases.

### **Q: What are mitochondria and how do they cause disease?**

Mitochondria are structures that operate like tiny power plants in all of our cells. They carry a small set of genes, much smaller than the number of genes carried in the cell nucleus. Despite their limited number, genes in the mitochondria often mutate, causing numerous serious diseases.

**Q: What specific techniques were used to prevent these mutations from being passed along?**

A: Shoukhrat Mitalipov, Ph.D., and his colleagues were able to remove the nuclear genes from a monkey's egg cell. In doing so, they left behind the mitochondria containing the mitochondrial genes. The scientists then transplanted the nuclear genes taken from the first monkey into the egg cell taken from another monkey. This second egg cell had also previously had its nuclear DNA removed. The end result was an egg cell carrying nuclear DNA from the mother, but the mitochondrial DNA from the donor.

**Q: How could this breakthrough be translated into human therapy?**

A: This therapy would specifically be used in cases where a woman is known to be carrying mitochondrial-based disease. There are various ways in which this can be determined, such as the birth of a previous child with mitochondrial disease or a family history of mitochondrial disease. In these situations, the technique could allow women to have children free from the risk of diseases carried by mitochondrial gene mutations.

**Q: Are the monkeys that were born using this procedure healthy?**

A: Yes. All four monkeys (named Mito, Tracker, Spindler and Spindy) that were bred via this technique are healthy. It is also worth noting that prior to studies in animals, this technique was first attempted in hundreds of individual animal egg cells. However, these cells were not implanted into monkey "mothers." This prior line of testing was conducted to determine the safety and success rate of this procedure before using it in live animals.

**Q: Why do you think it will work in humans following research in monkeys?**

A: Because of some key similarities between monkeys and humans, studies in non-human primates can provide a large amount of data that correlates to human health. Animal studies are a necessary and important step in curing and preventing disease. They serve as the bridge between science in a test tube and human cures. In this case, the animals played an irreplaceable role. Monkeys were used for this study because their reproductive systems are very similar to humans. Working with monkey egg cells provided researchers with important safety data. This successful research in monkeys strongly suggests this new technique could be applied to humans.

**Q: Are there ethical issues related to this research?**

A: This is a form a germ line therapy, which means its impacts would be felt in future generations of humans if they were born using this technique. The research team believes that before this technique is used in humans, a healthy public discussion that includes scientists, physicians and ethicists must take place. The researchers also maintain that the focus of this technique should always be geared toward the prevention of serious diseases.

**Q: How far are we from using this technology in humans?**

A: While researchers believe this technique could be translated to humans within a few years, there is much more research to be done. In addition, current U.S. law restricts the use of government funding to study this technique using human cells. Public and private investments (such as the Oregon Opportunity, which funneled nearly \$600 million of public and private money into biomedical research at OHSU) help advance the work that must be done to fully explore whether this technique will be safe and appropriate for humans.

For more information, including videos of the monkeys and of the mitochondrial replacement process, go to [http://www.ohsu.edu/xd/about/news\\_events/news/gene-therapy-prevent-disease.cfm](http://www.ohsu.edu/xd/about/news_events/news/gene-therapy-prevent-disease.cfm)