

# Explaining mitochondrial donation treatment: how a baby has three parents

MDT is the process through which an egg, which has the genetic material (DNA) from the parents, and mitochondria from a selected female donor, is implanted in the uterus, and carried to full term to yield a baby, free of any mitochondrial disease

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**T**he announcement that a baby was born using three persons' DNA in the U. K. on Thursday caused the stir that news of this kind was expected to evoke. The baby, technically, has three parents, deriving the mitochondria from a donor apart from the genetic material (DNA) from biological parents. Pioneering technology was used to facilitate this, in order to prevent the child from inheriting the mother's mitochondrial disease.

## Why did the baby need 'three parents'?

The baby carried most of its DNA from its parents, and a minor per cent from the donor, whose mitochondria has been used while fertilising the egg.

Mitochondria are basically the powerhouses of the cells. They generate energy, and thus are also responsible for cell function in the human body. Certain defects might occur impacting the way the mitochondria produces energy for the cells (especially in the 'energy-hungry' tissues of the brain, nerves, muscles, kidneys, heart, liver), and thereby impacting cell function. The diseases that arise out of such mitochondrial mutations are called mitochondrial diseases. When the mitochondria are impaired and do not produce sufficient energy, it affects how

organs function, leading to a broad assortment of symptoms across the body, including brain damage, organ failure and muscle wastage. The symptoms get more and more debilitating as a child grows, and have no cure, but can be treated. Some estimates put the incidence of mitochondrial diseases as one in 5,000 people.

In this case, the mother had a mitochondrial disease she was intent on not passing on to her baby. She also did not want to have a donor egg, for the baby would carry the genetic material of the donor.

## What is the scientific process?

Mitochondrial diseases are only passed on by the mother, and research has been attempting to find a way for protecting the infant from inheriting the disease.

Here, through an advanced in vitro fertilisation technique developed and refined by the Newcastle Fertility Clinic, the baby's biological father's sperm was used to fertilise the eggs from the biological mother, who has a mitochondrial disease, and a third, female donor with clear mitochondria, separately.

Then, the nuclear genetic material from the donor's egg is removed and replaced with the genetic material from the biological parents'. The final product – the egg – which has the genetic

material (DNA) from the parents, and the mitochondria from the female donor, is implanted in the uterus, and carried to full term to yield a baby who will be free from the mother's mitochondrial disease.

This process is termed Mitochondria Donation Treatment (MDT).

Priya Selvaraj, Scientific and Clinical Head, GG Hospitals, Chennai, an IVF centre, says: "If we are talking about inheriting genetic mitochondrial diseases then it's maternal. That's why this particular technique is of relevance. This is specifically only for couples who wish to have their genetic child and are not okay with using a donor egg. With this special process, the final cytoplasm (which holds the genetic material and mitochondria) has healthy mitochondria while the genetic material belongs to the biological parents."

## Is there a law to facilitate MDT?

The Guardian reported that "research on MDT, which is also known as mitochondrial replacement therapy (MRT), was pioneered in the U. K. by doctors at the Newcastle Fertility Centre... to help women with mutated mitochondria to have babies without the risk of passing on genetic disorders."

The progress in research led the U. K. government to amend the law allowing the procedure in 2015. It was further added that it was two years later that the

Newcastle clinic became the first centre to get a licence to perform it, and the first few cases were approved in 2018.

"Approval is given on a case-by-case basis by the U. K.'s Human Fertilisation and Embryology Authority (HFEA), which has given the green light for at least 30 cases," the paper said. While details of the cases were not revealed to the media to protect the identity of the patients, a freedom of information application by The Guardian revealed that there were "less than five cases".

The Newscientist reported in 2016 of a Jordanian baby born of 'three parents', with a technique employed by the team led by John Zhang at New Hope Fertility Centre in New York, but working in Mexico.

## Are there any side effects to the procedure?

The Guardian, quoting a Pubmed article from February this year, has mentioned that sometimes it is possible that a small amount of the maternal mitochondria with errors may get passed on during the procedure. Dr. Sevaraj makes the case for more information on the process itself, "while largely helpful, the procedure is not without these minimal risks. As for the process, they use terms such as reversion or reversal and it's inexplicable as of now. More published data is needed to establish consensus."