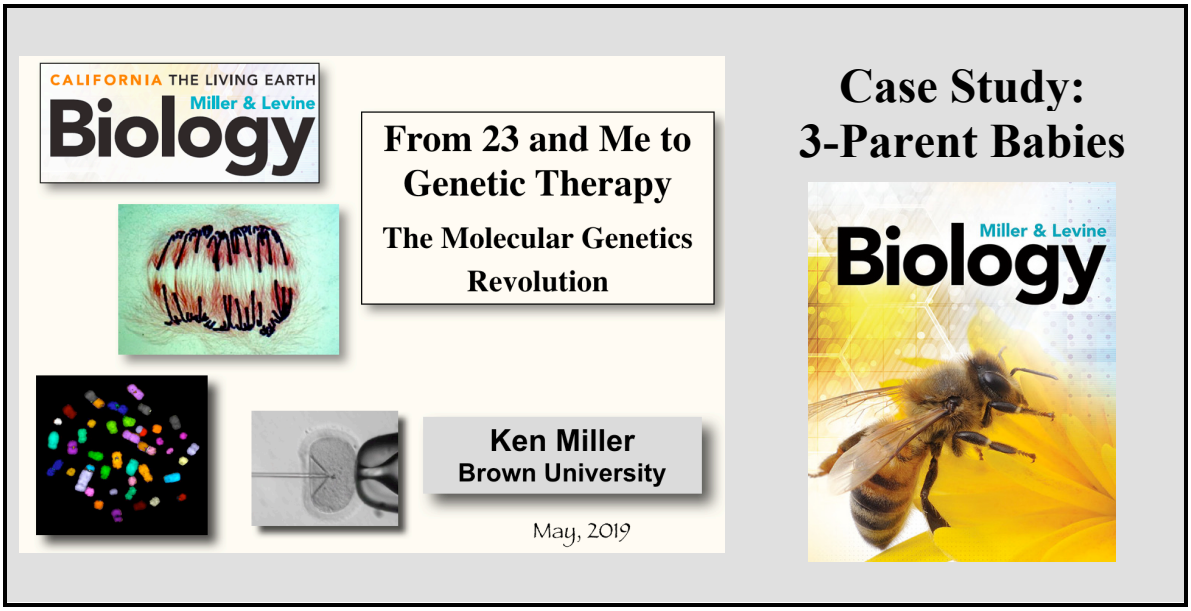


Background

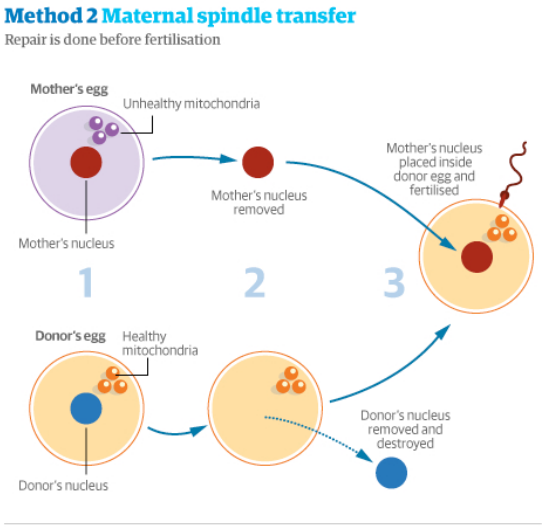
3-parent offspring are nothing new. When Dolly the sheep was cloned in 1996, most of her genome came from the nucleus of an adult sheep that had been transplanted into an enucleated egg cell. However, her mitochondrial genome came from the donor of the egg cytoplasm into which that nucleus was transplanted.

With the discovery of mitochondrial genetic disorders, scientists began to wonder if it might be possible to eliminate such disorders by the use of a "third parent" to donate egg cytoplasm with healthy mitochondria into which a nucleus produced by two other parents might be transplanted.

Birth of the first 3-Parent Baby

In April 2017 physicians in New York City announced the birth of the first 3-parent baby in the United States. The child was born to two parents whose previous attempts to have children were

unsuccessful a mitochondrial disorder known as Leigh Syndrome found in the mother's organelle DNA. By a technique known as Spindle Transfer, she and her husband were able to produce a healthy child whose mitochondria came from an egg cytoplasm donor.

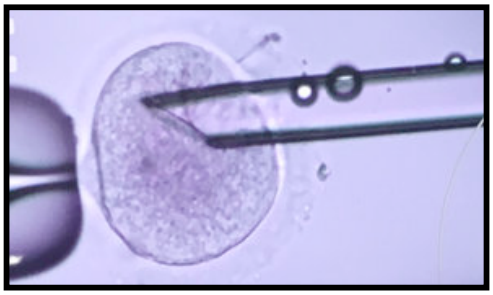


Possible Applications

More then 30 known human genetic disorders have been mapped to the 37 genes in the human mitochondrial genome. All of these disorders run in families where they are passed along via the maternal line of descent. While some are debilitating or potentially fatal, others are of a less serious nature. Potentially, all of these disorders could be eliminated from the families in which they are found by means and spindle transplantation into cytoplasm obtain from a third parent mitochondrial donor.

Questions to Discuss

Safety Research has demonstrated that interactions between the nuclear and mitochondrial genomes are extremely complex. Should we go ahead with these procedures if they have the potential to upset the genetic relationship between these two organelles in an unknown way?



Equity and Necessity At the present time the cost of these procedures is extremely high. As a result, will they be restricted to those who can afford them, or will they be a way to make them available to all those who need them? In addition, might it not be better social policy to advise couples at risk of genetic disorders to forgo having children of their own and consider adoption as an alternative?

Ethical Considerations While few would argue against the use of mitochondrial transfer to eliminate or cure genetic disorders, it is worth considering cases where the procedure might be used more for genetic enhancement than for medical necessity. Should parents be allowed to shop for and to purchase egg cytoplasm with potentially superior mitochondria that might aid in athletic performance or provide other qualities that might enhance the lives of their offspring? Would such procedures be an ethically defensible use of this powerful technology?