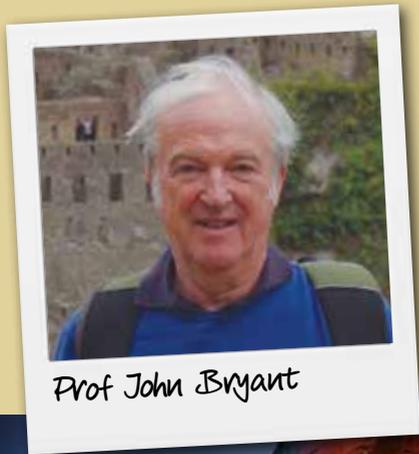


## Comments

Application of these techniques to human embryos is motivated by a desire to avoid human suffering and on those grounds, Christians with the more liberal view of the embryo may find at least embryo selection (and perhaps the other two) acceptable. However, these techniques are open to abuse, possibly leading to 'designer babies'. For mitochondrial transfer and especially genome editing there are

possible but unknown risks to the health of the child who will be born and possibly to later generations. For those holding the stricter view of the embryo, even the humanitarian motive may not be enough to find these techniques acceptable, especially if embryos are to be used essentially as experimental material to see if a technique works (see above). There are times when we must accept with grace differences in opinion amongst us.



Prof John Bryant

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## Further information

[www.cis.org.uk](http://www.cis.org.uk) – Christians in Science

## Further Reading

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# Genes and Embryos

## Should we genetically edit the human embryo?

ADDRESSING QUESTIONS OF SCIENCE AND FAITH



THINKING ABOUT...

# Genes and Embryos

Prof John Bryant

...the moral and spiritual status of the preimplantation embryo...is a very sensitive area, with distinct differences of opinion between Christians.

**It is important in the context of this leaflet to know about early embryo development.** Fertilisation itself takes about ten hours, leading to the single-celled embryo. Even then, the two sets of genetic material (technically, the male and female pro-nuclei) remain separate and do not merge to form a single nucleus until the four-cell stage. Cell divisions continue and at about six days after fertilisation, the embryo may implant in the wall of the uterus to establish a pregnancy. The failure rate at this stage is very high.

In IVF these stages of development may be observed outside of the body; further, it was the development of IVF from 1978 onwards that led to our ability to use genetic technologies with human embryos. In respect of ethics, the discussion can be traced back to the ethics of IVF itself – in particular, to the moral and spiritual status of the pre-implantation embryo. It is a very sensitive area, with distinct differences of opinion between Christians. Some believe that from the completion of fertilisation, the embryo should be treated as if it was a born human person; indeed, some say

that the Bible teaches that these early embryos carry the image of God. On that basis, the creation of 'spare' embryos (routine in IVF) is wrong: there can be no such thing as a spare person. Others, with equal respect for the Bible, argue that it does not and indeed could not teach that (because in Biblical times this pre-pregnancy phase of development was unknown – conception meant becoming pregnant); for this reason and for reasons based on the science, they have a more 'liberal' attitude towards the embryo. So, the view you hold will affect how you regard the genetic procedures which I now describe. I will therefore only comment where new issues arise.

## Genetic selection of embryos

Pre-implantation mammalian, including human, embryos, are developmentally very 'flexible'. It is possible to remove one cell at the eight-cell stage; the embryo still develops normally. Further, techniques for analysing DNA have become so powerful that the DNA from a single cell is enough for the detection of specific genes. In the late 1980s the technique of pre-implantation genetic diagnosis (PGD) was developed. A couple who are at high risk of passing on a serious genetic disorder to their babies may elect to go for IVF and PGD in order to

implant only embryos that are free from the relevant mutation. Other embryos will be rejected. There are worries that this can be used for non-medical reasons. However, in the UK, the guidelines under which the Human Fertilisation and Embryology Authority (HFEA) operates are very clear (and have not been breached in over 25 years): the procedure must only be used for medical reasons.

## Mitochondrial DNA transfer

The procedure described above is about selection of embryos with or without particular genes. It does not involve GM (changing the genetic make-up of an embryo). Indeed, the law forbids heritable GM, even though it is an entirely feasible procedure. However, recently an exception has been made. Mitochondria are the particles in cells that provide cellular energy. They carry a small number of genes (about 0.17% of the total number) and are inherited only from the mother. Mutations in mitochondrial DNA cause a range of serious diseases, most of which cause death in infancy (sometimes very early) or childhood while others cause progressive disabilities in young adults. PGD (see above) is for various reasons not feasible. So, to help a mother who is very likely to pass on a mitochondrial disease to her children, techniques have been developed in which all her genetic material, with the

exception of mitochondrial genes, can be transferred into a donor's egg with healthy mitochondria (which has had its main genetic material removed). The details are unimportant here, except to say that one of the techniques involved will effectively result in the loss of one newly fertilised egg (one-cell embryo). There are two further points. First, the use of a donor egg and its mitochondria, albeit emptied of its main set of genes, has led to this being called, somewhat misleadingly, three-parent IVF. Secondly, 'swapping' mitochondria is certainly a form of heritable GM.

## Genome editing

From 2013 onwards, an easy-to-use genome editing technique (another form of GM) has been developed. It has already been shown to be capable of removing specific tracts of DNA, e.g. genes and then either allowing the gapped DNA to re-join or (but with greater difficulty) insert another segment of DNA. Thus it could be used to remove a faulty gene and replace it with the functional version. Attempts to do this with human embryos have been attempted by Chinese scientists. Further, at the time of writing (early February 2016) the HFEA has, somewhat controversially, given a British research group permission to do similar 'proof of concept' experiments, even though the developers of the technique oppose its use on human embryos.

APPLICATION OF THESE TECHNIQUES IS MOTIVATED BY A DESIRE TO AVOID HUMAN SUFFERING