



## ISTT Statement of Principles Gene-Editing of Human Embryos

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Genetic engineering in animals is a process that has engendered great excitement as well as great anxiety. The technology is used to study developmental processes (using small animals such as the mouse, zebra fish, fruit fly, worm, etc.), determine gene function, and mimic human and animal disease processes. Perhaps the greatest promises of this technology are to develop and test drugs and to perform gene therapy, both of which are intended to prevent or cure disease.

Until recently, a variety of limitations made the technology impractical for all but a few species of animals (primarily mice). However, with the advent of new gene-editing systems, where components are inexpensive, readily generated in the laboratory, and applicable to virtually any species, it is now feasible to perform genetic engineering in the human embryo. Changes made in an embryo brought to term would no longer be confined to that individual, but could be passed through the germline to affect future generations.

A recent publication [Liang, P. *et al. Protein Cell* <http://dx.doi.org/10.1007/s13238-015-0153-5> (2015)] brought this reality squarely into the public consciousness. In this study, the CRISPR/Cas9 system was used to edit the genome of human embryos. To their credit, the authors were careful to use only non-viable embryos. Furthermore, their detailed examination of the engineered embryos revealed both the intended and unintended modifications that resulted. This study clearly demonstrates that the CRISPR/Cas9 system is currently too imprecise and inefficient for genetic engineering of human embryos for implantation, gestation and birth.

Members of the ISTT use CRISPR/Cas9 technology, as well as other gene-editing technologies, routinely. Many of our members have had integral roles in the development of these technologies and therefore recognize the power of these systems. It is with that knowledge and foresight that the ISTT Board of Directors issues this statement (while understanding that more nuanced discussions and decisions will be needed as the technology improves):

- Genetic engineering technology, in its current state, is error-prone and must not be used in human embryos intended for implantation.
- Studies to test new genetic engineering technology in human embryos should be postponed until proven completely safe and effective in other species.
- New methods of genetic engineering must be carefully assessed to ensure that risk to the human population is negligible.
- Uses of genetic engineering in human embryos should be limited to disease mitigation for those diseases where no other option is available; we reject the idea of “designer babies.”
- We strongly urge worldwide agreement on minimum standards for gene editing experiments in human embryos, and will promote such measures with our members. Until such standards have been established, we remain opposed to making any genetic alterations in human embryos that could be inherited by future generations.