Cloning

Cloning is the use of technology to make an exact genetic copy of a living organism. The term may also be used to apply to making a copy of simple cells, a gene or a segment of DNA. Reproductive cloning is the cloning of a human being. Nuclear transfer (or 'therapeutic cloning') involves the use of embryonic stem cells for therapeutic purposes.

Cloning is controversial. Australian legislation prohibits human cloning for reproduction. 'Therapeutic cloning' has potential that is supported by most of the scientific community.

Reproductive cloning
Reproductive cloning is the use of technology to create a living copy of an existing human. This is largely condemned by the international scientific community. Some commentators believe that human cloning could one day become a reality, because our increasing acceptance of genetic technologies may 'desensitise us' to the ethical dilemmas involved. At the present time, however, there are significant scientific, technological and ethical barriers to reproductive cloning.

Humans and other mammals use 'sexual reproduction' – the mother's egg is fertilised by the father's sperm – so that the baby has a combination of genes from both parents (one set from each). Cloning is 'asexual reproduction' because both sets of genes come from one 'parent'. The resulting offspring born from cloning technology has the same genetic makeup as its original parent. The offspring will not be absolutely identical to its original parent, however, because of differences in the mitochondrial DNA and different pregnancy and postnatal environmental influences.

Cloning techniques
Some of the current cloning techniques include:

- **Somatic cell nuclear transfer** – cells from the original organism, called 'donor cells', are grown in the laboratory. The female egg (ovum) is prepared by having its genetic material removed. The selected donor cell is placed next to the empty ovum and a small electrical current allows the genetic material from the donor to fuse into the ovum. The ovum, with its complete set of genes, is 'tricked' into thinking it has been fertilised, and so develops into an embryo. The embryo is then transferred into a prepared uterus. To date this has not been achieved in humans.
- **Embryo splitting** – the simplest way to create a clone is to prompt a fertilised egg to split in two. Soon after fertilisation, the fertilised egg divides to form an embryo. The cells of the embryo are called blastomeres. Using special instruments, the coating of the fertilised egg (the zona pellucida) is taken away. The blastomeres are teased apart and each coated with an artificial zona pellucida, which prompts them to start growing as individual embryos. This technique has been employed for stock breeding. In practice, it is only possible to get a maximum of four embryos using this method.

Possible uses of human cloning technology
Some of the possible uses of human cloning technology may include:

- **Infertility** – cloning either the mother or the father may be the only way an infertile couple can have a child. Other options are usually available.
- **IVF technology** – couples undergoing IVF technology could increase the number of available embryos implanted into the woman's uterus if each fertilised egg was prompted technologically to divide in two and become twins.
- **Single women and lesbians** – women who desire children but don't have, or don't want, male partners could clone themselves.
- **Bringing back the dead** – for example, grieving parents may want their dying or dead child cloned.

Ethical concerns regarding reproductive cloning

As reported in the 1998 *Australian Health Ethics Committee Report* to the National Health and Medical Research Council, some of the ethical dilemmas of reproductive cloning include:

- The desire to have one's own children is strong, but cloning either the mother or father doesn't produce offspring in the normal sense – the child is the product of the genetic material of only one parent.
- Cloning carries considerable and unknown risks for the baby, including premature ageing and many biological, social and psychological repercussions. The desire to have one's own child may not be a good enough reason to subject a baby to the risks of cloning.
- A dead child can't be 'brought back to life' by being cloned. The cloned child will be the lost child's genetic double, or twin, but not that child. The concept that the dead can be reborn through cloning negates the individuality of human beings and the environmental factors that contribute to individuality.
- Any attempt to reproduce asexually goes against both human biology and human culture, including our definitions of the family.
- Loss of autonomy infringes the concept of uniqueness and individual autonomy.
- There is no medical justification for reproductive cloning.

Nuclear transfer ('therapeutic cloning')
Cloning an existing human for medical purposes is called nuclear transfer (formerly known as 'therapeutic cloning'). This procedure employs a similar technique to somatic cell nuclear transfer (SCNT) but the embryo is never implanted into a uterus. The embryonic stem cells are harvested for therapeutic use and could potentially even be grown into replacement organs and tissues. As the cells are immunologically compatible with the original donor of the genetic material, this avoids tissue rejection by the immune system. To date this has not been achieved in humans.

There are strong advocates for nuclear transfer, which could produce embryonic stem cells for therapeutic purposes. Other ways of obtaining embryonic stem cells for therapeutic purposes include:

- Harvesting embryonic stem cells from **spare embryos** donated by couples undergoing IVF treatment
- Harvesting embryonic stem cells from **embryos deliberately created** for this purpose (the embryos are never implanted).

Producing a cloned human being to act as a tissue or organ donor is generally not acceptable to the majority of people in the community.

Potential applications of stem cell research and therapeutic cloning
Possible applications of stem cell research and therapeutic cloning include:

- Treatment of a person with disorders such as Parkinson's disease and dementia – the embryonic stem cells, generated from the cells of the individual, would be immunologically compatible
- Study of early human development
- Screening of drugs that may cause birth defects
- Pharmacogenomic research on disease-specific stem cells to provide information on new and targeted drug treatments
- Disease-specific stem cell lines would provide the opportunity to learn about the mechanism of disease and make preliminary treatment trials more accessible.

Ethical concerns regarding therapeutic cloning
Some of the ethical concerns regarding therapeutic cloning include:

- Transplant organs would need to be made from embryonic stem cell lines. This means that human eggs would be deliberately fertilised so that their cells could be harvested for others. It has been argued that creating a clone so that its tissue can be transplanted into the 'original' person cheapens life and makes the cloned embryo simply a means to an end.
- Some regard the preimplantation embryo as a very special cell culture, a 'possible life' but not truly a 'potential life' until it is successfully implanted and an ongoing pregnancy. Others regard the harvesting of stem cells, which in effect destroys the embryo, as destroying human life.

- Harvesting human eggs involves the donor in treatments that have some (quite small) health risks related to superovulation. The long-term risks are yet to be established. The risk is justified in the setting of IVF treatment but is questionable where there is no direct benefit to the donor.
- There is concern about inequity of access to this technology, if it were to be available only to those who can afford to pay for it.

Cloning and the law

Commonwealth and Victorian legislation bans human cloning for reproduction. In 2005 the Lockhart Review recommended approval of stem cell research and somatic nuclear transfer. The national *Prohibition of Human Cloning for Reproduction* and the *Regulation of Human Embryo Research Amendment Act 2006* came into operation on 12 June 2007. The use of SCNT to create cloned human embryos in order to derive embryonic stem cells (sometimes called 'therapeutic cloning') is allowed under licence. Researchers must abide by the provisions of the National Statement on Ethical Conduct in Human Research (2007).

In Victoria, the *Health Legislation (Research Involving Human Embryos and Prohibition of Human Cloning) Act* (2003) prohibits human cloning and certain other practices associated with reproductive technology. The Act provides for penalties of up to 15 years jail in some instances if the law is broken. Under this legislation:

- Embryos cannot be created purely for the purposes of research
- Research on spare embryos is permitted
- Research on imported embryos is permitted.

The above Victorian legislation was reviewed in 2008.

Where to get help

- National Health and Medical Research Council, Health Ethics Section Tel. (02) 6217 9070

Things to remember

- Cloning is the use of technology to make an exact genetic copy of a living thing.
- Cloning is a controversial technology and the idea of cloning human beings for reproductive purposes is largely condemned by the international scientific community.
- Nuclear transfer (previously known as 'therapeutic cloning') has potential that is supported by most of the scientific community.
- Victorian legislation was reviewed in 2008.

This page has been produced in consultation with, and approved by:

Genetic Health Services Victoria