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# STEM CELLS

Stem cell therapy and research has been a focus of media attention over the past decade. The potential to use stem cell therapy in horse injuries is now a reality. However, the therapeutic application of stem cells is still in its infancy and must be considered a developing technology.

### What is a stem cell?

A stem cell is a type of unspecialised cell that has the ability to be transformed into any number of different specialised cell types. In other words, from a stem cell a variety of different tissues may be created such as muscle, bone, tendon, cartilage, skin or nerve to name a few. Potentially stem cells may be used to reproduce the majority of different tissues in the body.

Stem cells are also typically able to continue dividing and renewing themselves in cell culture (in the laboratory) for a prolonged period of time. They can be stored long term by freezing, allowing thawing at a later date and subsequent multiplication in cell culture.

Stem cells can be obtained from a variety of sources and are named differently as to their source. Embryonic stem cells are obtained from an embryo typically at day 5 after fertili-

sation when the embryo has about 200-250 cells. This typically means destruction of the developing embryo in order to harvest the cells. Thus, the moral and ethical dilemma created when human embryonic stem cells are used for both therapy and research has been the focus of much debate.

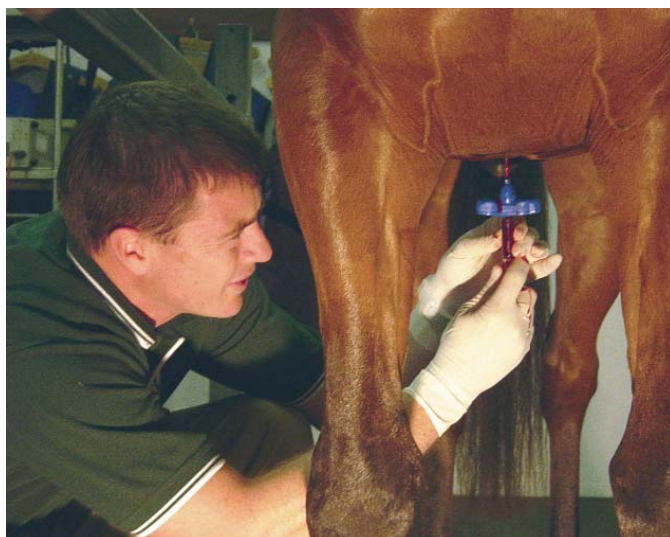
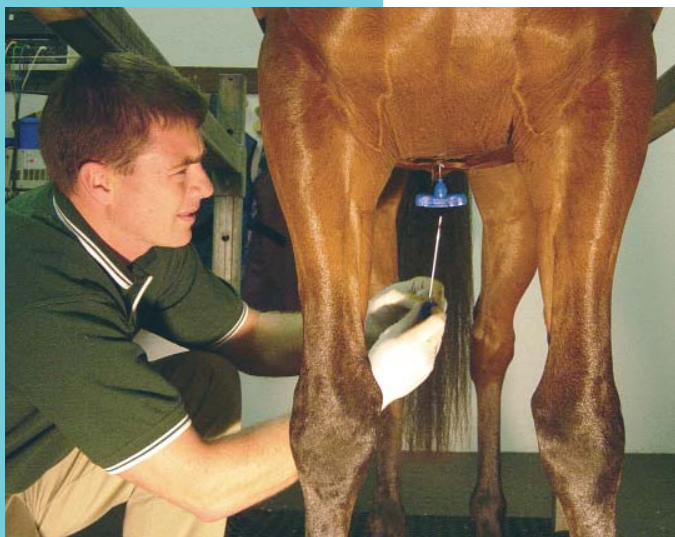
Adult (somatic) stem cells are obtained from adult tissues including brain, bone marrow, peripheral blood, blood vessels, skeletal muscle, fat, skin and liver. Adult stem cells are in very low numbers in these tissues, but when samples of these tissues are collected, stem cells can be harvested from the adult, cultured and grown up to large numbers. Stem cells are also present in the umbilical cord blood at birth.

### How are stem cells obtained from the horse?

Currently in Australia, stem cells are obtained from umbilical cord blood after foaling or from adult horses' bone marrow. The cord blood derived stem cells can be frozen and kept until later in the horses' career when they may be required for treatment.

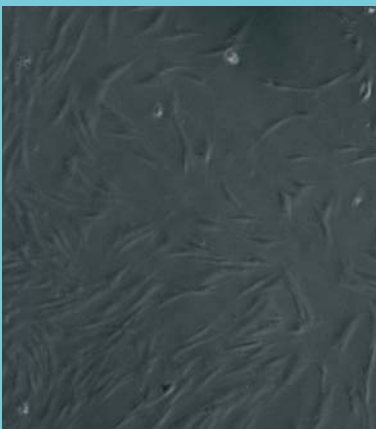
Alternately stem cells can be obtained from other tissues, most commonly in the adult horse they are

*Figure 1 and 2 Obtaining bone marrow from the sternum of a standing sedated horse is relatively easy.*





**Figure 3**  
*Bone marrow ready for harvesting of stem cells.*



**Figure 4**  
*Equine bone marrow derived stem cells in culture. These cells are part of a research project between Randwick Equine Centre and Dr Clive McFarland and Pankaj Godara from the Graduate school of Biomedical Engineering at The University of New South Wales.*

obtained from bone marrow. There is also the potential to obtain stem cells from other easily accessible regions (including fat) in the adult.

Currently in Australia, there is a South Australian company (Vet Biotechnology) that will be offering a stem cell service for both cord blood and bone marrow. This will allow veterinarians access to stem cells for therapy throughout Australia.

#### **What are stem cells being used for currently in the horse?**

At this time stem cells are being used most commonly for treatment of tendon and ligament injuries. If a tendon or ligament injury occurs two scenarios exist. In the case of a horse that has had cord blood taken as a foal, the stored cells are thawed and grown up in culture. Alternatively bone marrow is obtained and shipped to the lab for harvesting and culture of stem cells. Once a sufficient number of cells have been grown up (typically taking a couple of weeks in culture). The cells are resuspended in serum or supernatant and injected under ultrasound guidance into the tendon or ligament injury (likely around 3-6 weeks after the original injury).

Currently research is ongoing in the use of stem cells for replacement of damaged joint surfaces in traumatic arthritis. Assuming that the current advances in application of stem cells in human medicine continue, the veterinary profession will also benefit.

#### **What is the difference between bone marrow injection and stem cell therapy for treatment of tendon or ligament injuries?**

Bone marrow injection has been popularised in the U.S.A for treatment of ligament and tendon injuries. It involves obtaining bone marrow and injecting bone marrow into a tendon or ligament injury. This can be considered a very crude form of stem cell therapy and the numbers of stem cells are very low with only about 1 in 100 000 cells in the marrow actually being

a stem cell. There have been complication reported with the injection of bone marrow into tendons. The most concerning are reports of mineralisation (calcification) of the tendon.

Stem cell therapy on the other hand takes only the adult stem cells from the bone marrow and discards the other cells and blood. The stem cells are then cultured to much greater numbers (approximately 2 million cells over about two weeks), prior to being injected into the tendon or ligament injury.

#### **What does the future hold for stem cell therapies?**

The future is promising for the application of stem cells in the treatment of injury and disease. However, at this stage there are many technical hurdles between the promise of stem cells and maximising the benefits of their application. Therefore at this stage, stem cell therapy in the horse should be considered as an advancing but still experimental treatment.

At this early stage there are insufficient numbers of horses with tendon and ligament injuries treated with stem cells to make a judgement as to the end benefit. Based on the current experimental and clinical knowledge the future looks promising. It is likely as with any new therapy that with time the treatment will evolve. Advances in the use of growth factors and gene therapy combined with stem cells will likely broaden applications and provide greater treatment efficacy in the long term. **R**

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