Tissue-derived stem cells which can be cultured from adult and foetal tissues have already been used clinically, and are under extensive research in regenerative medicine. Blood stem cell transplantation has been used already for 40 years. Embryonic stem cells which can be derived from four to six day old embryos after in vitro fertilisation, are a promising cell source because of their pluripotency and unlimited capability to divide. They have not yet been used clinically.

Stem cells repair all tear and wear in the body. Actively renewing tissues, such as skin and intestinal mucosa, contain large numbers of stem cells and progenitor cells. Muscle is renewed and injuries repaired by satellite cells. Bone and cartilage have their stem cells. There are small numbers of stem cells also in adult nervous system.

In many organs, the regenerative ability is limited, and the numbers of stem cells decrease by aging. Using cell transplantation, we can overcome situations in which the body’s own reparative capacity is limited.

Chondrocytes have been used for years to repair injured cartilage. Mesenchymal stem cells cultured from bone marrow or adipose tissue, give origin to cartilage and bone. These tissues can be cultured in biomaterial scaffolds for treatment of injuries. To isolate and propagate mesenchymal stem cells from adipose tissue is less invasive than cartilage biopsy. It is already today possible to form soft tissues by tissue engineering, also by using mesenchymal stem cells. Tendon injuries are common in connection with physical exercise. Adipose tissue derived mesenchymal stem cells integrate well to tendons. In Regea, we have cultured such cells from horses with tendon injuries, and the results in the runner horses are promising. The clinical applications in human are also on hands.

Neurological disorders are among the main targets of stem cell therapy. Neural cells differentiated from embryonic stem cells are today the most promising source of cells for such therapies. Peripheral nerve injuries, spinal cord injury and Parkinson’s disease have, for example, been successfully treated in animals. In human, severe neurological disorders will be the first indications for using embryonic stem cell derived cells. For spinal cord injury, differentiation of neural progenitor cells, motoneurons and oligodendrocytes is already feasible, and functional tests in animals are going on. Cardiac failure is another indication for stem cell therapy, also with embryonic stem cells.

Stem cells can be transduced, making them optimal cells for certain types of gene therapy, but there are still safety issues to be solved before clinical use.

Exercise and hypoxemic conditions promote the self-renewal of many stem cells in the body. This may be one of the mechanisms how exercise promotes physical abilities. It is clear that stem cell therapy promotes physical performance by healing severe injuries. It is not clear whether stem cells can enhance normal performance.

Keywords: Tendon, Cellular Biology