

<p>Adult stem cells (◆ASC◆) are unspecialized or undifferentiated cells found throughout the body after embryonic development. ASC◆s can be found in juvenile as well as adult animals and humans.</p> <p>The primary roles of adult stem cells in a living organism are to maintain and repair the tissue in which they are found.</p> <p>The history of research on adult stem cells began about 50 years ago. In the 1950s, researchers discovered that the bone marrow contains at least two kinds of stem cells. One population, called hematopoietic stem cells, forms all the types of blood cells in the body.</p> <p>A second population, called stromal stem cells (also called mesenchymal stem cells, or skeletal stem cells by some), were discovered a few years later. These non-hematopoietic stem cells can generate bone, cartilage, fat, cells that support the formation of blood, and fibrous connective tissue.</p> <p></p> <p>◆</p> <p>An adult stem cell can be found among differentiated cells in a tissue or organ, and can renew itself and can differentiate to yield some or all of the major specialized cell types of the tissue or organ. ASC◆s are found in many adult tissues including the bone marrow and adipose tissue.</p> <p>ASC multiply by cell division to replenish dying cells and regenerate damaged tissues.</p> <p>Scientific interest in adult stem cells has centered on their ability to divide or self-renew indefinitely, and generate all the cell types of the organ from which they originate, potentially regenerating the entire organ from a few cells.</p> <p>Adult stem cells (ASCs) lie dormant (quiescent) and non-dividing within different adult human tissues until they are activated by signals from diseased, dying or damaged tissue to not only divide to form more stem cells, but also to differentiate into different types of specialized cells to replenish or regenerate these affected cells.</p> <p>ASCs were generally thought to be 'multipotent' lineage-restricted cells with the ability to only differentiate into types of cells predetermined by the germ layer-origin of the tissue within which they reside. However, in vitro studies have shown that, given the right conditions, some ASCs can differentiate into cell types of germ-origin different to their tissue of origin. This is called Trans-differentiation or Plasticity. This makes these ASCs 'pluripotent' and hence very attractive in on-going stem cell research to find ways of culturing and transplanting healthy cells to replace diseased, damaged or dying tissues.

Originally identified as a source of osteoprogenitor cells, MSCs differentiate into adipocytes, chondrocytes, osteoblasts, and myoblasts in vitro (Hauner et al., 1987 ; Grigoradis et al., 1988 ; Wakitani et al., 1995 ; Ferrari et al., 1998 ; Johnstone et al., 1998 ; Pittenger et al., 1999) and undergo differentiation in vivo (Benayahu et al., 1989 ; Bruder et al., 1998a), making these stem cells promising candidates for mesodermal defect repair and disease management.</p> <p></p> <p>ASCs can be described in a number of ways depending on their potency, germ layer of origin, or their tissue of origin. For example, ASCs present in adipose tissue may be called Multipotent,

Mesenchymal, Adipose-derived, ASCs.

Adult stem cell treatments have been successfully used for many years to treat leukemia and related bone/blood cancers through bone marrow transplants in humans. Adult stem cells have also been used extensively in veterinary medicine to treat arthritis in dogs as well as tendon and ligament injuries in horses.

The use of adult stem cells in research and therapy is not as controversial as embryonic stem cells, because the production of adult stem cells does not require the destruction of an embryo.

Given both the clinical and ethical issues surrounding the use of embryonic stem cells, Australian Veterinary Stem Cells has been pursuing the use of adult stem cells from adipose tissue (ADMSCs) in the treatment of a number of conditions in the veterinary setting.

Adipose-derived adult mesenchymal stem cells (ADMSC) are multipotent and can differentiate into tendon, ligament, bone, cartilage, cardiac, nerve, muscle, blood vessels, fat, and liver tissue (see figure below). The stromal fraction that is harvested from adipose tissue is a heterogeneous mixture of regenerative cells (see below).

Adipose tissue represents a source of stem cells that is having far-reaching effects in a large number of fields of medicine. ADMSC cells have potential applications for the repair and regeneration of acute and chronically damaged tissues.