



## Current Therapeutic Applications of Adipose Stem Cells

Vedat Karasu\*

Department of Pediatric Stem Cell Transplantation, Medicalpark Antalya Hospital, Antalya, Turkey

### DESCRIPTION

#### Fat grafting and tissue reconstruction

The first attempt at the method of fat grafting was made in 1889. Since then, numerous efforts have been undertaken to develop a common methodology that will produce optimum results. ASCs, SVF, and Cell Assisted Lipotransfer (CAL) have all shown promise for enhancing and regenerating adipose tissue. ASC administration improves the results of fat grafting in humans, especially in applications for breast reconstruction, face reconstruction, and cosmetic surgery. This is primarily attributable to ASCs' capacity to differentiate into endothelial and epithelial cells, as well as their ability to secrete cytokines and growth factors that stimulate angiogenesis through paracrine mechanisms and cell-cell interactions in a co-culture system, enhancing neovascularization and speeding wound healing.

Rebuilding tissues that have undergone surgical oncological therapies and repairing face soft tissue often involve the utilisation of fat reconstruction. However, the success rate of fat transplants differs between patients, which may be caused by a number of factors, such as the techniques used to isolate ASCs, the surgery, and the location of the fat transplant.

#### Bone defects

The "critical-size bone defect" idea restricts the possibility for regeneration in bone tissue, despite the fact that bone tissue has a built-in capacity for repair and regeneration. Simply put, this idea refers to the point at which the lesion has spread too far to allow for efficient signal transduction and growth factor delivery to promote regeneration. At this point, scaffolds and stem cells, including ASCs, are necessary. However, after blood, bone-derived grafts are the most often implanted material. With open fractures, only 28% of patients are able to fully recover on their own. Osteoblast, osteoclast, and osteocyte cells are the three types of cells that make up bone tissue and maintain its structural integrity. Osteoclasts and osteoblasts must interact for bone remodelling and regeneration to occur. It has been

demonstrated in numerous investigations that ASCs can develop into osteoblasts. Their differentiation and bone regeneration are improved by the addition of extracellular calcium, growth hormones, PRP, and Bone Morphogenetic Protein 2 (BMP-2).

Studies have revealed that ASCs-Exo can induce bone regeneration through a paracrine mechanism in addition to their therapeutic efficacy. Decellularized adipose tissue hydrogels have also showed promise in animal models, particularly when paired with ASCs. When the scaffolds are treated with either ASCs or osteogenic lineage produced ASCs and hydroxyapatite, the decellularized adipose tissue scaffolds encourage bone regeneration and a greater volume of partially mineralized tissue, as well as higher amounts of collagen and osteopontin.

#### Cartilage regeneration

The potential for cartilage to regenerate is often limited. Articular cartilage is the most often treated kind of cartilage, with joint damage and Osteoarthritis (OA) as the primary therapeutic objectives in regenerative medicine. The use of autologous and allogeneic ASCs injections, ASCs-Exo, and ASCs-CM in clinical trials for the treatment of knee osteoarthritis has been reported to be well tolerated and to produce positive outcomes in terms of pain relief, reduced stiffness, and increased physical function without experiencing any negative severe side effects.

#### Spinal cord injuries

In both a small (rats) and a large (pigs) animal model of spinal cord injury, a group investigated the therapeutic potential of mesenchymal stem cells extracted from either bone marrow, adipose tissue, or dental pulp. This was done during the spinal contusion subacute stage. When combined with fibrin matrix, ASCs considerably outperformed other MSCs in the rat model of post-traumatic regeneration. Although brain tissue integrity was restored after the application of ASCs implanted in the fibrin matrix at the SCI site in pigs, no appreciable functional gains were noticed. A few case studies using ASCs in people with spinal cord injuries have successful results.

**Correspondence to:** Vedat Karasu, Department of Pediatric Stem Cell Transplantation, Medicalpark Antalya Hospital, Antalya, Turkey, E-mail: Vedat\_Karasu@yahoo.com

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