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Multipotent adult stem cells (MASCs): Differentiation and regeneration

Tissue regeneration in adult humans requires large number of cells. We are working with a unique population of adult stem cells: multipotent adult stem cells (MASCs). MASCs have properties which make them uniquely useful for tissue regeneration: 1) an apparently unlimited proliferation potential *in vitro*, 2) the ability to differentiate into phenotypes of all 3 dermal lineages, 3) ability to respond to local signals to differentiate to the tissues at the site and 4) do not elicit an immune rejection response. MASCs have been isolated from embryonic chicks, adult rats, mice, rabbits, and humans. They have been isolated from skeletal muscle, bone marrow, fat, and skin. MASCs from all species and all tissues are isolated and cultured by the same protocol, and they all exhibit the same proliferative and differentiation behavior *in vitro* and response to local factors *in vivo*. Differentiated phenotypes observed *in vitro* include skeletal myotubes, chondrocytes, osteoblasts, adipocytes, smooth muscle cells, endothelial cells, cardiomyocytes, fibroblasts, astrocytes, neurons, oligodendrocytes, keratinocytes, hepatocytes, pancreatic islet cells, and epithelial cells. Rat MASCs have been taken to 300 cell doublings, mice to 600 cell doublings, and human to 100 cell doublings. *In vivo* regeneration models where MASCs have been tested include meniscal defect in rabbits, cartilage defects in rabbits, femoral and calvarial bone defects in rats, dermal defects in rats, an open tibial defect in rats, and injection sub-q of human MASCs into young adult rats. In the open tibia defect (Fig 1), MASCs were observed to differentiate into 7 phenotypes: keratinocytes, hair follicle cells, gland cells, endothelial cells, smooth muscle cells, fibroblasts, and periosteum. When injected into young adult rats, human MASCs were observed to differentiate into endothelial, smooth muscle, and hair follicle keratinocytes. MASCs have the potential to regenerate tissues and become a useful tool in regenerative medicine.

Biography

Paul Lucas earned his PhD in Biochemistry from the University of Minnesota. He was a Post-doctoral Fellow with Dr. Arnold I Caplan from 1986 to 1987. He was an Associate Professor of Surgery at Mercer University School of Medicine. From 1997, he has been Director of Orthopaedic Research and Associate Professor of Orthopaedic Surgery and Associate Professor of Pathology at New York Medical College, Valhalla NY. He is an inventor of 6 issued patents and 2 patents pending. His research has focused on adult stem cells and tissue regeneration.

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