

Ovine Disc Regeneration by Hydrogel System in Combination with AMSC

H.J. Meisel^{†‡}, A. Friedmann^{*‡}, F. Goehre^{†‡} and S. Schwan^{*‡}

[†]BG Hospital Bergmannstrost Halle
Merseburger Str. 165, 06112 Halle, Germany
felix.goehre@bergmannstrost.de
meisel@bergmannstrost.de

[‡]Translational Centre for Regenerative Medicine (TRM) Leipzig University
Philipp-Rosenthal-Str. 55, 04103 Leipzig, Germany
andrea.friedmann@trm.uni-leipzig.de
stefan.schwan@trm.uni-leipzig.de

^{*}Fraunhofer Institute for Mechanics of Materials
Walther-Huelse-Str. 1. 06120 Halle, Germany

Introduction:

Due to changed ways of life and the increasing life expectancy, the therapy of disc degeneration and its secondary diseases belongs to the most important sociomedical problems. Until today, the therapy of intervertebral disc disease is mainly based on the surgical removal of the cartilage tissue, protruding between the vertebrae. Such a sequestrectomy means a permanent loss of tissue. Regenerative implants on the basis of cell transfer, can offer a promising alternative to conventional therapies. From a clinical point of view, it is assumed that a self-regenerative implant based adipose mesenchymal stem cells (AMSC), combined with an injectable scaffold material, represents a crucial improvement of the mechanical long-term stability of damaged intervertebral disc segments.

Method:

The intervertebral discs of adult female sheep, 2 years of age, were mechanically damaged. Subsequently, approximately 3 g of adipose tissue was taken from each sheep. From this tissue, the AMSC were recovered through outgrowing and expansion in a cell culture system, up to a number of approximately 10^7 cells. The addition of growth factors was omitted. After scar tissue has formed over the damaged annulus fibrosus, the cell differentiation was induced in combination with a collagen based hydrogel in the disc. Euthanasia was carried out after a standing time of 3, 6, 12 months to display the regeneration progress, as examined by CT, μ CT and histologically.

Results:

Approximately 6 weeks after inducing damage, a dense scar tissue over the defected site was observed. The injected mixture of cells and the hydrogel remains within the nucleus pulposus. The damage to the cells throughout the injection is minimal. At all three points throughout the study, an even distribution of cells in the nucleus tissue is present. Typical signs of degradation, characteristic of the formation of cell clusters, could not be observed. It is observed that in

comparison to the negative controls, a definite decrease in disc height could be stopped through treatment. The formation of tumors could not be observed over the period of one year.

Conclusions:

The application of a hydrogel AMSC may be a suitable treatment in intervertebral disc degeneration. Even if a regeneration of disc tissue cannot be proven, a progressive height loss, as a result of degeneration, could be prevented.