Methods to monitor distribution and metabolic activity of mesenchymal stem cells following in vivo injection into nucleotomized porcine intervertebral discs.

Intervertebral disc (IVD) degeneration involves a series of biochemical and morphological changes leading to loss of spinal stability and flexibility. Cell therapy is promising to reconstitute IVDs with new cells, however, sustained metabolic activity seems crucial for an active contribution to regeneration. The aim of the present study was to establish methods for separate follow up of persistence and activity of autologous porcine mesenchymal stem cells (pMSC) after implantation into IVDs of Goettingen minipigs in vivo in order to conclude about the potential of such an intervention strategy. For quantitative follow up, the transfer matrix was supplemented with Al(2)O(3) particles and pMSC which were retrovirally labeled with firefly luciferase (pMSC-Luc). Six mature Goettingen minipigs underwent matrix based cell transfer after partial nucleotomy of lumbar IVDs (n = 24). Day 0 and day 3 segments were analyzed for retained volume of Al(2)O(3) particles by micro-computed-tomography (muCT) and for cell activity by luciferase enzyme assessment. Three days after injection a reduction of Al(2)O(3) particles (P = 0.028) to about 9% and of pMSC-Luc activity to about 7% of initial values (P = 0.003) was detected, which suggests loss of 90% of the implant material under in vivo conditions without evidence for...
reduced pMSC-Luc metabolic activity (P = 0.887). In conclusion, separate follow up of implant material and cell activity was possible and unravels problems with in vivo implant persistence after annular puncture rather than quick loss of cell activity. Therefore, IVD-regeneration-strategies should increasingly focus on annulus reconstruction in order to reduce implant loss due to annular failure.