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Osteogenic differentiation of human mesenchymal stem cells and amniotic fluid stem cells in large, biodegradable scaffolds

Peister A, Rodriguez DE, Prince JJ, Gray DP, Gower LB, Guldberg RE Morehouse College, Department of Biology, USA Cell-based tissue engineering strategies represent a clinical alternative to bone grafting. The success of cell-based therapies for bone regeneration has been limited in part by inadequate availability of large quantities of osteogenic cells. The goals of this study were to determine the potential of AFS cells to differentiate into osteoblasts, produce mineralized matrix *in vitro*, and support bone formation in *in vivo* ectopic bone defect models.

Cells were grown on a 3-dimensional (3D) PCL scaffold produced through fused deposition modeling with a porosity of 85%. To increase cell viability and differentiation, the cell-seeded PCL scaffolds were placed in dynamic perfusion throughout the differentiation *in vitro*. We found that AFS cells mineralization initially lagged that of MSCs but caught up by 7 weeks of culture. Interestingly, the rate of mineral production between 5 and 15 weeks was significantly higher in the AFS cells than the MSCs. At 15 weeks *in vitro*, cells were located throughout the scaffold with very high cell viability.

Preliminary *in vivo* studies were performed with AFS cells seeded on PCL scaffolds and then differentiated for varying amounts of time *in vitro* prior to subcutaneous implantation. Robust mineralization was seen only in the AFS cell constructs pre-cultured for 4 weeks. These results suggest that *in vitro* pre-differentiation is required for AFS cells to form bone at an ectopic site *in vivo*. Future studies will examine and compare the abilities of the MSCs and AFS cells to accelerate functional repair of large segmental bone defects in rats.

Biography

Alexandra Peister completed her PhD in human genetics in 2004 from Tulane University. Postdoctoral research was conducted at Georgia Institute of Technology and Emory University Department of Biomedical Engineering. Since 2007 she has been an Assistant Professor of Biology at Morehouse College in Atlanta, GA. She has published 18 peer-reviewed papers as well as contributed to book chapters.