Reaming Material Contains Human Mesenchymal Stroma Cells With High Osteogenic Potency

Pamela Kuehlfluck¹, Gerhard Schmidmaier, Prof. MD², Tamara Jefferson-Keil, Dr. rer. nat.².
¹University, Heidelberg, Germany, ²Universitätsklinikum Heidelberg, Heidelberg, Germany.

Disclosures:

Introduction: The Golden standard for treatment of non-union is presently the transplantation of autologous spongy bone from iliac crest. One alternative technique could be stem cell based Tissue Engineering. With the Reamer-irrigator-aspirator (RIA)-system autologous material could be harvested by femoral reaming. The reaming material is set within the bone defect for treatment of pseudarthrosis. The aim of this study is the in vitro characterization and in vivo analysis of ectopic bone formation of human mesenchymal stroma cells (hMSC) from various tissues like reaming material (filtrate RIA and native RIA), bone marrow aspirate from iliac crest (BMSC) and fat tissue (ADSC).

Methods: Human mesenchymal stroma cells of nine donors were isolated and cultivated from reaming material, iliac crest bone marrow aspirate and fat tissue. The cells were analyzed for stemness by determination of cell surface antigens (CD73, CD90, CD105, CD146, CD34 and CD45), colony-forming unit fibroblast assay and differentiation capacity in osteoblasts, adipocytes and chondrocytes in vitro. Furthermore gene expression profiles for osteogeneous pattern was realized. For in vivo analysis, the ability of new bone formation by colonization of the bone substitute β-tri-calcium phosphate with hMSC harvested from various tissues was realized.

Results: The results show, the verification on stemness of human mesenchymal stroma cells, by realization of trilineage differentiation, flow cytometry and colony-forming unit fibroblast assay. HMSC could be isolated from the tissues reaming material, iliac crest bone marrow aspirate and fat tissue. Human mesenchymal stroma cells harvested from reaming material possesses a higher osteogenic potency in vitro and in vivo compared to hMSC from iliac crest. Ectopic bone formation from reaming material could be detected from every donor. Furthermore, the amount of newly built bone from hMSC of reaming material was nearly twice as high compared to hMSC from iliac crest. Human mesenchymal stroma cells from fat tissue showed nearly no ectopic bone formation.

Discussion: Reaming material is a promising source for human mesenchymal stroma cells. Moreover, reaming material component filtrate RIA exhibits a higher osteogenic potency in vitro and in vivo than hMSC from iliac crest. Another big advantage of reaming material is its recovery directly from bone tissue. Although other scientists are discussing the stemness and furthermore assume, that pericytes have the same characteristics (2-3), we have confident data that human mesenchymal stroma cells are involved in bone formation. So this leads us to the conclusion, that the application of reaming material in clinical treatment is an attractive alternative to the golden standard.

Significance: Statistical analyzes were performed by non-parametric Friedman-test and *p≤0.05, **p≤0.01, ***p≤0.001 was considered significant. If significances were seen by Friedman test the post hoc non parametric Wilcoxon test was used to analyze two paired samples on its equality.

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Figure 1: Osteogenic differentiation in vivo of implants.
After HE staining of implant constructs, new bone formation was
determined by densitometry from resorbed material.
(filtrate RIA, native RIA), iliac crest bone marrow aspirate (BMSC)
and fat tissue (ADSC); n = 9: ADSC levels are significant in filtrate RIA
(**p=0.008), native RIA (*p=0.012) and BMSC (*p=0.021).

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