Poly-lactic-co-glycolic acid with nano-scale topography influences murine mesenchymal stem cell function and differentiation

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Statement of Purpose: The size of tissue-derived fibroblast populations is inadequate for tissue regeneration, requiring a more abundant fibroblast source. mesenchymal stem cells (MSCs) can differentiate into fibroblasts and represent a practical stem cell model for the development of clinical tissue regeneration techniques. Greater osteoblast adhesion and lower fibroblasts adhesion were shown on nano-surfaced poly-lactic-co-glycolic acid (nPLGA) when compared to conventional PLGA (cPLGA), demonstrating scaffold topography's influence on cell function. There are, however, little data on scaffold topography's effect on MSC functions including adhesion, proliferation, collagen synthesis and differentiation. Understanding scaffold topography's influence on MSC function may lead to ample fibroblast populations suitable for tissue regeneration. The goal of this study is to determine the effect of PLGA scaffold topography on MSC proliferation, adhesion, collagen synthesis and differentiation (measured by morphologic changes).

Methods and Materials: cPLGA (Polysciences, Warrington, PA) was fabricated using the salt leaching method. nPLGA was fabricated by etching cPLGA scaffolds in 1N sodium hydroxide (NaOH) (figure 1).

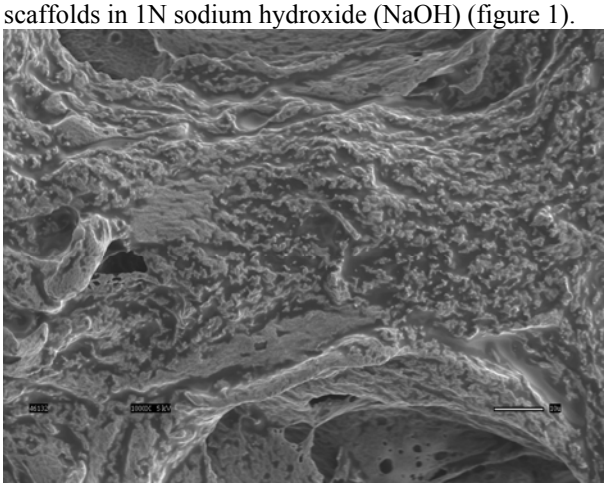

Figure 1.Scanning electron micrograph depicting minute surface details created through NaOH etching. Scale bar = 10 μm.

Murine MSCs were seeded onto cPLGA or nPLGA scaffolds and were maintained separately in Dulbecco's Modified Eagle Medium (DMEM, HyClone; Logan, UT) with 10% fetal bovine serum (FBS) (HyClone; Logan, Utah) and 1% penicillin/streptomyocin (P/S) under standard culture conditions of 37^{o}C in humidified 5% CO_2/95% air. MSC adhesion, proliferation, collagen synthesis and differentiation on the seeded scaffolds were analyzed after 4 hours, and 1, 3, and 14 days. MSC adhesion and proliferation were quantified using a CytoTox 96 assay. Collagen synthesis was quantified using confocal microscopy. MSC morphology was visualized using environmental scanning electron microscopy (ESEM).

Results: Preliminary results suggest that MSC adhesion is decreased on nPLGA while MSC proliferation is increased. The spindly (fibroblast-like) morphology of the cells suggests that MSC's are following a fibroblastic lineage.

Conclusion: The results suggest that scaffold topography should be factored into tissue engineering procedures where adequate cell numbers must be achieved. Increased cell populations allow for increased matrix production which increases implant integrity and decreases wound healing time.