Differentiation Potential of Human Adipose Derived Stem Cells as a Function of Electrospun Silk Fibroin Mesh Alignment

Rebecca McMahon, Ph.D., Tejaswi Iyyanki, M.S., Charles E. Butler, M.D., Anshu B. Mathur, Ph.D.*
The University of Texas, M.D. Anderson Cancer Center,
Department of Plastic Surgery, Houston TX, 77030
*Corresponding author: Anshu Mathur Ph.D., amathur@mdanderson.org, (713)563-7568

Cell-biomaterial interactions influence cell behaviors, such as alignment, matrix deposition, and differentiation. One strategy for the design of tissue engineering scaffolds is to mimic the structure of the tissue of interest as architectural features of tissue engineering scaffolds, like a fibrous structure and alignment, may promote differentiation into tissues of interest. In this experiment, we hypothesized that the scaffold architecture (aligned versus unaligned fibers) would affect motility, morphology, and differentiation lineage of human adipose-derived stem cells (hASC). Silk fibroin (SF), a protein-based polymer, is a promising scaffold material that was selected to mimic collagen in native tissues. Aligned and unaligned SF meshes were fabricated with electrospinning, a technique capable of producing non-woven meshes with fibers in the micro- and nano-scale. The fiber size distribution, alignment, and surface chemistry were assessed to ensure that scaffold properties were consistent with the exception of alignment as shown in **Figure 1**.

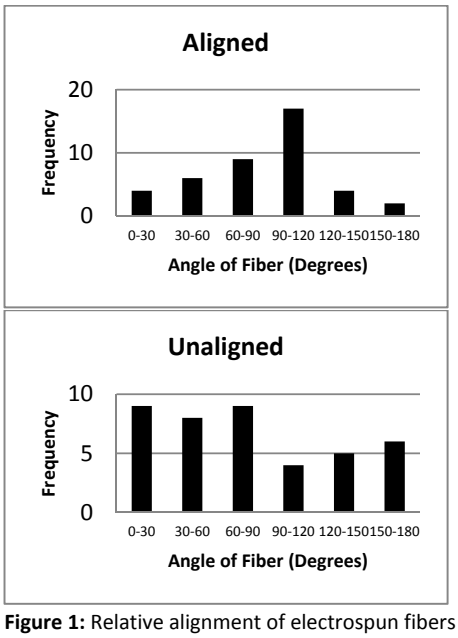

Figure 1: Relative alignment of electrospun fibers

Due to their mesenchymal differentiation potential, and ease of isolation at the time of surgery, hASCs were selected for this study. hASCs were cultured on the aligned and unaligned fiber meshes with a mixed culture medium that possesses factors for bone, cartilage, and fat differentiation. This media was selected so that any lineage was a possibility, and the cell behavior was a function of the scaffold morphology alone. Cells cultured on these fibrous scaffolds were compared to cells grown on smooth silk surfaces and tissue culture plastic. Cell motility, morphology, and differentiation were then assessed. By the 24 hour time point, hASCs align along fibers, resulting in a polarized morphology in the direction of alignment, as compared to the more randomly oriented cells on the unaligned and smooth SF scaffolds (**Figure 2**). This shows that scaffold architecture alone is affecting cell morphology. Since cellular morphology changes during the differentiation cycle of a stem cell, the architecture of the SF scaffolds can potentially direct differentiation.

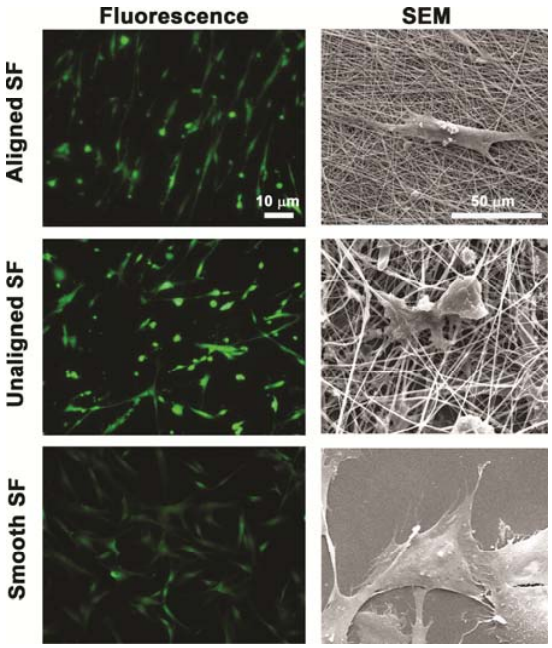

Figure 2: Cell morphology on electrospun fibrous SF scaffolds as compared to a smooth SF surface at 24 hr timepoint