Influence of Patterned Electrospun Nanofiber Meshes on Human Dermal Fibroblasts, Keratinocytes and Adipose Stem Cells Behaviour

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Natural extracellular Matrix (ECM) creates a unique cellular microenvironment. It acts as a support to organize cells in tissues, maintains their structure and works also as a reservoir for cytokines, thus controlling cell growth and differentiation. A well-defined biomaterial surface topography is believed to be adequate to mimic native ECM for guiding cell growth or tissue regeneration. This structure can be achieved by using an electrospinning technique, which allows producing a non-woven nanofibrous structure with topographic features mimicking the natural ECM [1].

This study evaluates the influence of micro-topography of patterned Polycaprolactone (PCL) nanofiber meshes, aimed at being used in skin regeneration approaches. The morphology, adhesion and proliferation of primary cultures of human keratinocytes (hKC), dermal fibroblasts (hDFs), and adipose-derived stem cells (hASCs), isolated from the abdominal region, was evaluated after seeding in those structures .

In vitro studies showed that the characteristic morphology of each cell type and respective phenotype was maintained on the patterned electrospun nanofiber meshes during the culture period. SEM micrographs demonstrated that these cells adhered better on the randomly distributed areas (Fig. 1B) of the nanofibers than in the aligned ones. Furthermore, DNA quantification and metabolic activity analysis confirmed the enhanced performance of the cells adhered on the random structures. Additionally, the patterned areas were able to induce cell alignment along the nanofibers (Fig. 2).

The combination of the organized and random structures into patterned nanofiber meshes, being able to control cell distribution and proliferation, showed promising characteristics for upcoming studies regarding skin tissue engineering applications.

References:

[1] Neves N.M., Campos R., Pedro AJ, Cunha J., Macedo F., Reis RL, Patterning of polymer nanofiber meshes by electrospinning for biomedical applications. International Journal of Nanomedicine, 2007. 2(3): p. 433-48

Figures:

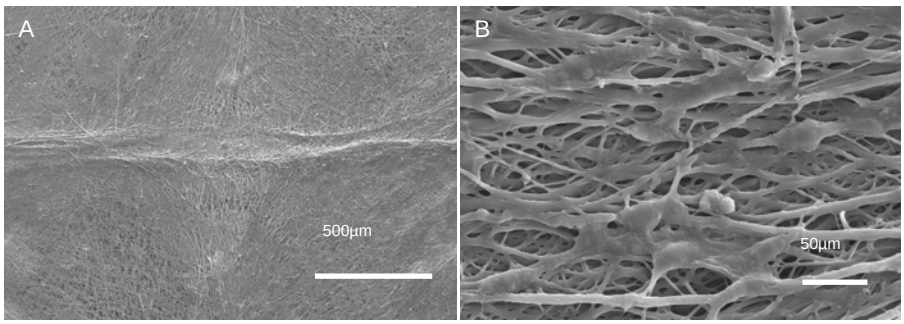

Figure 1- SEM micrograph of A) random and aligned electrospun nanofibres and B) HDFs in electrospun PCL patterned nanofiber meshes after 14 days of culture.

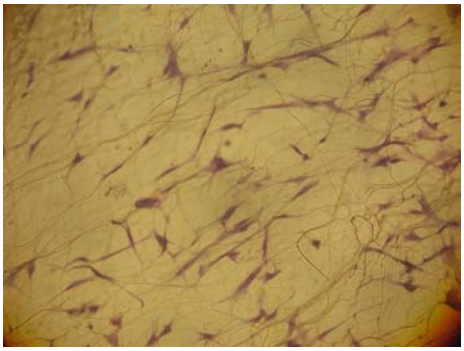

Figure 2- Cell alignment along the nanofibers.