A full-thickness skin construct made of a collagen hydrogel strengthened by a fibrin-modified nanofibrous membrane

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Introduction

For many years, a three-dimensional (3D) collagen hydrogel has been used for embedding the fibroblasts to provide them with physiological 3D environment. However, the stiffness of tissue-engineered skin analogues based on collagen hydrogels is insufficient. The cell traction forces typically cause the shrinkage of the hydrogels. In order to improve the mechanical properties of a two-layer skin construct, we stabilized the collagen hydrogel by fibrin-modified nanofibrous membrane.

Materials & Methods

Nanofibrous polylactid acid (PLLA) membranes were modified with fibrin homogenous mesh. Fibrin-modified membranes were seeded with human dermal fibroblasts (FIB) or adipose-derived stem cells (ASC). After few days, collagen hydrogel was applied on the surface of fibrin-modified membranes pre-seeded with fibroblasts or stem cells, and then primary keratinocytes (KERAT) were seeded on the surface of collagen hydrogel. Cell proliferation, migration and morphology were evaluated by super-resolution microscopy.

Results

1. Fibroblasts on fibrin-coated PLLA membrane

2. Fibroblasts migrated into collagen gel from fibrin-modified PLLA membrane

3. Bilayered construct of fibroblasts and keratinocytes strengthened by fibrin-modified membrane