An Engineered Novel Spatially Controlled Collagen Density Gradient Biomaterial For Soft Tissue Surgery

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INTRODUCTION:

Collagen makes up 30% of tissue ECM and it is the integral component of many human tissues[1]. It has been demonstrated that by increasing the density of the collagen construct, its mechanical properties can be enhanced while conserving its capacity to induce good cell proliferation[2]. The objective of this study was to engineer a collagen graft with enhanced regenerative and mechanical property by structural modification of the collagen matrix for soft tissue surgery application.

MATERIALS & METHODS:

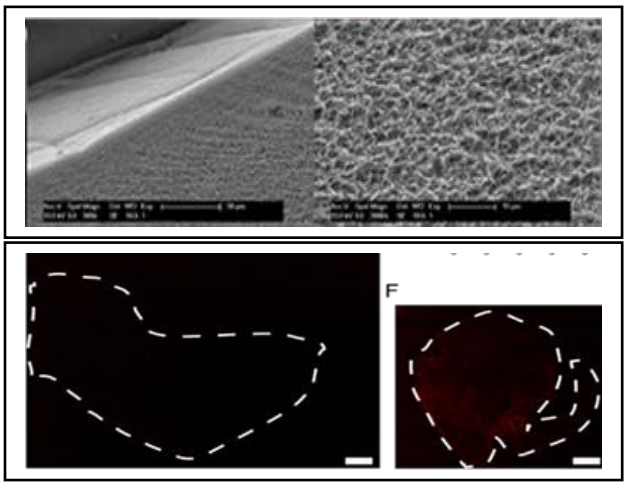
Engineered biomaterials were tested on an *in vitro* assay to look at cell behavior and preference to density and structure. Instron tensile machine (Norwood, MA, USA) was used to evaluate the collagen grafts elastic modulus (Young's modulus) and ultimate tensile strength (UTS).

RESULTS:

Spatially controlled collagen density grafts were engineered (Figure1). Evaluation of the interaction of muscle cells within a dense and less dense 3D collagen matrix was evaluated. In low-density rat tail collagen gels (0.5 mg/cm3), it was noted that human smooth muscle cells induce remodeling and degrading of the initial collagen matrix faster as compared to smooth muscle cells in high-density collagen gels when cultured for 7 and 14 days (1 mg/cm3) (Figure 2). Analytical mechanical testing and empirical assessment of collagen biomaterials with different liquid was done. Mechanical tensile tests revealed, that the UTS and Young's modulus depended on the liquid content in the grafts

Figure 1: SEM images of fabricated biomaterial.

Figure 2: Immunohistochemistry of human collagen type 1 expression in 1 mg/cm3 and 0.5 mg/cm3 rat-tail collagen grafts seeded with human smooth muscle cells at day 14 (Scale bar 500 µm).



DISCUSSIONS:

The biomaterial design was inspired by the *in vitro* cell fate assessment of smooth muscle cells in different mechanical niches. A novel fabrication method was developed to achieve both a surgical compatible and a cell instructive material. This resulted in the engineering of a final relatively easy to fabricate acellular bovine collagen graft with enhanced mechanical property, allowing for better surgical and regenerative outcome.

CONCLUSION:

This study demonstrated that density modification on the engineered collagen grafts influences smooth muscle cells proliferation.

ABSTRACT TRUNCATED