Chitosan/Poly(ε-caprolactone) Blend Scaffolds for Cartilage Repair
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Introduction
The limited intrinsic capacity for articular cartilage (AC) to repair itself is well known. Efforts in cartilage tissue engineering (TE) approaches rely on seeding AC chondrocytes on biodegradable scaffolds. The main structural advantages of fiber-based scaffolds are increased surface area and enhanced interconnected architecture. Chitosan (CHT) has some unique properties such as structural similarity with glycosaminoglycans found in AC. However, its mechanical properties are poor in aqueous environments [1,2]. The aim this study was to improve the mechanical properties of CHT scaffolds by mixing CHT with poly(ε-caprolactone) (PCL) – a bioreabsorbed hydrophobic polymer – and test the biological performance of these composite scaffolds.

Materials and Methods
CHT, PCL, formic acid and methanol where purchased from Sigma–Aldrich. Before being used, CHT was purified by recrystallization, according to a method described elsewhere [2]. Fiber-based Scaffolds Fabrication and Characterization, CHT and PCL were dissolved in pure formic acid to prepare CHT and CHT/PCL homogeneous blend solutions. Different quantities of CHT and PCL were added to the solvent in order to obtain 100, 75 and 50 wt.% CHT in the CHT/PCL blends (CHT, 75CHT and 50CHT, respectively). Fiber processing was performed by wet spinning [2]. The obtained fibers were folded into cylindrical moulds and dried at 60°C for 3h. The scaffolds structure and topography were studied by scanning electron microscopy (SEM). Biological Studies. Bovine articular chondrocytes (BAC) were isolated from a calf knee and, after their expansion, each scaffold was seeded with 5x10^5 cells. Constructs were cultured for 1, 3, 7, 14 and 21 days. Cell viability was assessed at all time points using a Live/Dead assay. Cell’s metabolic activity and cell distribution in the scaffold was analyzed by a MTT assay.

Results
With increasing PCL content in the blends, the roughness of the fibers surface (Fig.1 A-C) and the metabolic activity of the chondrocytes increased correspondently (Fig.1 D-F). This was associated to with an increase in the number of cells adhered to the scaffold (Fig.1 G-I), and resulted in a better distribution of the cells in the scaffold.

Discussion and Conclusions
It is possible to correlate the fiber’s topography with cells’ behavior. Cells were viable and metabolically active in all the three different fiber compositions. In the CHT scaffolds, cells poorly attached, sometimes aggregating, which indicated a poor interaction with the biomaterial. The 50CHT scaffolds seemed to support the highest viability and metabolic activity. CHT biological performance was therefore enhanced, by an increase in surface roughness and improved surface energy.

References