Long-term stable fibrin gels for cartilage engineering.

Abstract:
It is essential that hydrogel scaffold systems maintain long-term shape stability and mechanical integrity for applications in cartilage tissue engineering. Within this study, we aimed at the improvement of a commercially available fibrin gel in order to develop a long-term stable fibrin gel and, subsequently, investigated the suitability of the optimized gel for in vitro cartilage engineering. Only fibrin gels with a final fibrinogen concentration of 25mg/ml or higher, a Ca(2+) concentration of 20mm and a pH between 6.8 and 9 were transparent and stable for three weeks, the duration of the experiment. In contrast, when preparing fibrin gels with concentrations out of these ranges, turbid gels were obtained that shrank and completely dissolved within a few weeks. In rheological characterization experiments, the optimized gels showed a broad linear viscoelastic region and withstood mechanical loadings of up to 10,000 Pa. Bovine chondrocytes suspended in the optimized fibrin gels proliferated well and produced the extracellular matrix (ECM) components glycosaminoglycans and collagen type II. When initially seeding 3 million cells or more per construct (5mm diameter, 2mm thick), after 5 weeks of culture, a coherent cartilaginous ECM was obtained that was homogenously distributed throughout the whole construct. The developed fibrin gels are suggested also for other tissue...
engineering applications in which long-term stable hydrogels appear desirable.