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A tissue engineered osteochondral composite for cartilage repair: an in vivo study

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This work aimed to validate the efficacy of a tissue engineered osteochondral composite for the treatment of cartilage lesion produced in adult pigs. The osteochondral composite was manufactured by combining an osteo-compatible cylinder and a neocartilagineous tissue obtained by seeding swine articular chondrocytes into a collagen scaffold. Articular cartilage was harvested from the trochlea of six adult pigs and was enzymatically digested to isolate the chondrocytes [Deponti D.et al. 2005]. The cells were then expanded in monolayer culture in chondrogenic medium and seeded onto a collagen scaffold. The collagen scaffold was preintegrated in vitro, macroscopically and microscopically, to a an osteo-compatible cylinder. The seeded osteochondral scaffolds were left in standard culture condition for 3 weeks with the addition of growth factors. At the end of culture time the osteochondral scaffolds were surgically implanted in osteochondral lesion performed in the trochlea of the same pigs from which the cartilage was initially harvested. As control, some osteochondral lesions were treated with acellular scaffolds and others were left untreated. After 3 months, the repair tissue of the three experimental groups was macroscopically analyzed and processed for histological and biochemical analysis. The hystologic ICRS II scale showed a statistically significant difference between the three experimental groups only in the parameters regarding the cell morphology and the surface/superficial assessment: the lesion treated with the unseeded osteochondral scaffolds showed higher values in chondrocytes morphology and in the superficial layer recovery, with respect to the lesions treated with the seeded scaffolds or left untreated. The biochemical analysis showed a higher DNA content in the lesion repaired with cellular scaffold and a higher GAGs/DNA ratio in the lesions with a spontaneous repair. The result of this study demonstrate that an osteochondral scaffold was able to repair an osteochondral lesion in an in vivo model of adult pigs, showing a good integration with the surrounding tissue. The quality of the repair was higher when the scaffold was not seeded with chondrocytes, but filled with cells migrated from subchondral bone. This tissue engineered osteochondral composite could represent a valuable model for further in vivo studies on the repair of chondral/osteochondral lesion.

References

Deponti D. et al. (2005) Fibrin-Based Model for Cartilage Regeneration: Tissue Maturation from In Vitro to In Vivo. Tissue Engineering Part A 2012, 18 (1).

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