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Cartilage Defect Treatment Using High-Density Autologous Chondrocyte Implantation

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Autologous chondrocyte implantation (ACI) is a worldwide recognized therapy to treat focal cartilage lesions. Since the first publication in 1994, it has evolved from the use of cell cultures as a cell suspension injected under a periosteal flap covering the defect, to the use of biomaterials such the type I/III porcine collagen membrane used in MACI. Here we describe the experiments followed by our group to develop a modification of MACI called High Density- Autologous Chondrocyte Implantation (HD-ACI) in which cell density is increased 5-fold. In classical ACI, 5 million of cultured chondrocytes were implanted in the cartilage defect, but the use of periosteum increased morbidity. In MACI, 20 million cells are seeded in a 20 cm² collagen membrane, so cartilage defects are treated with a density of 1 million cells per cm². In this case, surgeons observed that neo-formed tissue was soft and had scarce cell number. We proposed to increase cell density to 5 million cells per cm², and first of all we had to prove its safety and effectiveness in a sheep model. In these experiments, 1 million and 5 million chondrocytes as well as 5

million mesenchymal stem cells were tested in 1 cm² defects performed in the cartilage of the medial femoral condyle. In all animals, we carried-out other cartilage defects that were repaired with micro fractures. Histological and molecular studies demonstrated that the animals treated with 5 million chondrocytes regenerated cartilage defects with a better hyaline cartilage than those treated with 1 million cells while fibrocartilage was produced in the animals treated with mesenchymal stem cells and in the defects treated with micro fractures. Currently, 336 patients (251 in the knee, 82 in the ankle and 3 in the hip) have been treated with HD-ACI and in this work, we present the results of 176 treated in the knee, 48 in the ankle and 8 patients with bilateral knee cartilage defects, being both knees treated in a surgical act, under the same anesthesia. Our results demonstrate that HD-ACI is a safe and effective technique for the treatment of cartilage defects, giving rise a neo-formed hyaline tissue and improving clinical and subjective perception of the joint functionality.

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