Matrix-assisted autologous chondrocyte transplantation for remodeling and repair of chondral defects in a rabbit model.

Abstract:

Articular cartilage defects are considered a major health problem because articular cartilage has a limited capacity for self-regeneration (1). Untreated cartilage lesions lead to ongoing pain, negatively affect the quality of life and predispose for osteoarthritis. During the last decades, several surgical techniques have been developed to treat such lesions. However, until now it was not possible to achieve a full repair in terms of covering the defect with hyaline articular cartilage or of providing satisfactory long-term recovery (2-4). Therefore, articular cartilage injuries remain a prime target for regenerative techniques such as Tissue Engineering. In contrast to other surgical techniques, which often lead to the formation of fibrous or fibrocartilaginous tissue, Tissue Engineering aims at fully restoring the complex structure and properties of the original articular cartilage by using the chondrogenic potential of transplanted cells. Recent developments opened up promising possibilities for regenerative cartilage therapies. The first cell based approach for the treatment of full-thickness cartilage or osteochondral lesions was performed in 1994 by Lars Peterson and Mats Brittberg who pioneered clinical autologous chondrocyte implantation (ACI) (5). Today, the technique is clinically well-established for the
treatment of large hyaline cartilage defects of the knee, maintaining good clinical results even 10 to 20 years after implantation (6). In recent years, the implantation of autologous chondrocytes underwent a rapid progression. The use of an artificial three-dimensional collagen-matrix on which cells are subsequently replanted became more and more popular (7-9). MACT comprises of two surgical procedures: First, in order to collect chondrocytes, a cartilage biopsy needs to be performed from a non weight-bearing cartilage area of the knee joint. Then, chondrocytes are being extracted, purified and expanded to a sufficient cell number in vitro. Chondrocytes are then seeded onto a three-dimensional matrix and can subsequently be re-implanted. When preparing a tissue-engineered implant, proliferation rate and differentiation capacity are crucial for a successful tissue regeneration (10). The use of a three-dimensional matrix as a cell carrier is thought to support these cellular characteristics (11). The following protocol will summarize and demonstrate a technique for the isolation of chondrocytes from cartilage biopsies, their proliferation in vitro and their seeding onto a 3D-matrix (Chondro-Gide, Geistlich Biomaterials, Wollhusen, Switzerland). Finally, the implantation of the cell-matrix-constructs into artificially created chondral defects of a rabbit’s knee joint will be described. This technique can be used as an experimental setting for further experiments of cartilage repair.

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