P229

Evaluation of the biology of matrix associated autologous chondrocyte transplantation (MACT) in an equine model: results of a pilot study

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Purpose: To assess the biology and effectiveness of the matrix associated autologous cartilage transplantation (MACT) as a treatment for full thickness cartilage defects in a large animal model.

Methods and Materials: In a pilot study 200 mg cartilage were harvested arthroscopically out of the fetlock joints of four mare horses. After 4 weeks of cell cultivation, three scaffolds – a collagen I/III membrane, a hyaluronan membrane and a combined scaffold (collagen I/III and hyaluronan) – were placed and filled with autologous chondrocytes, which were reimplanted in a standardized cartilage defect created in the equine lateral patellafemoral joint in 3 horses. An untreated defect of the fourth horse was used as a control. Three months after implantation the horses were euthanised and the transplants were harvested arthroscopically out of the fetlock joints of four mare horses. After 4 weeks of cell cultivation, three scaffolds, – a collagen I/III membrane, a hyaluronan membrane and a combined scaffold (collagen I/III and hyaluronan) – were placed and filled with autologous chondrocytes, which were reimplanted in a standardized cartilage defect created in the equine lateral patellafemoral joint in 3 horses. An untreated defect of the fourth horse was used as a control. Three months after implantation the horses were euthanised and the transplants were harvested arthroscopically out of the fetlock joints of four mare horses.

Results: All defects showed a complete filling with cartilage like tissue. Histology revealed fibrocartilage tissue well integrated in the surrounding native cartilage. At the basis of the transplants hyaline-like cartilage could be detected. The Real time PCR revealed a reduced expression of collagen II and an increase of collagen I compared to native cartilage. Electronmicroscopy shows that differentiation starts at the border of the defect, the appearance of extracellular matrix and collagen II fibrils.

Conclusions: This animal model is the appropriate animal model for the MACT and a study including a larger number of subjects is planned. The created regenerative tissue showed significantly similarities to native cartilage therefore MACT is an applicable method for the treatment of full thickness cartilage defects.

P230

3D HR micro-MRI to quantify the medial tibial cartilage thickness progression in a rabbit Model of experimental osteoarthritis

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Purpose: To develop a 3 D High Resolution (HR) micro-MR imaging method to measure quantitatively in vivo and non-invasively the medial tibial cartilage thickness (MTCTh) in both normal and Anterior Cruciate Ligament Transection (ACLT) rabbit model of osteoarthritis.

Methods and Materials: Methods: Left knee of the 40 ACLT rabbits were imaged in vivo with a 7 Tesla micro-MRI system at 3 and 5 months after surgery and 10 normal rabbits were used as control at both imaging time points. Macroscopic and histological MTCTh evaluations were compared to final MR measurements.

Results: OA gross macroscopic score was significantly higher (p=0.001) in the OA rabbits than in the control group. A 3-D FLASH fat-suppressed MRI protocol was implemented leading to a 44µm3 isotropic spatial resolution. MTCTh varied longitudinally and differently depending on the measured area. The thinnest MTCTh was measured in the minimum osteophytes grade area. MTCTh was 92.3% and predictive negative value 81.25%, compared with macroscopic MI grading scales.

Conclusions: This radiographic atlas of OA individual features allowed non-invasive in vivo grading and was well correlated with final macroscopic evaluation.

P231

Radiographic Atlas of the Individual Features of Osteoarthrosis (OA) in the Knee Joint in the Rabbit Experimental Model

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Purpose: To create a radiographic atlas for grading knee joint osteoarthrosis (OA) in the rabbit ACLT experimental model of OA and compare the radiographic and the macroscopic grades.

Methods and Materials: In vivo digital radiographs of the left knee of 10 control and 40 operated rabbits were performed at 5 months. Two blinded observers graded the osteophytes with a 4 grade scale for the medial femorotibial compartment and a 3 grade scale for the femoral trochlea. Joint space narrowing and subchondral cysts were graded with a 3 grade scale. Radiography and final macroscopy were compared.

Results: A “rabbit bed” was customised to standardize the extended postero-anterior radiographic view. A radiographic atlas of OA lesions was created and compiled in a power point presentation. Mean (SD) Radiographic scores Osteophytes JSN (0-2) Subchondral cysts (0-2) MTCTh (0-2) and MRI OA scores were compared. Control group: N=10 0.3 (0.4) 0.7 (0.35) 0.4 (0.4) 0 (0) 0 (0) 0.1 (0.3) Operated group: N= 40 1.8 (0.7) *** 1.2 (0.5) *** 1.2 (0.4) *** 0.6 (0.7) *** 0.4 (0.6) *** 1.3 (0.8) *** Significance level p<0.001, Student’s paired t test. All radiographic scores were significantly higher in the operated group compared to the control group (p<0.001). Macroscopic and radiographic osteophytes grading were well correlated (r = 0.64, p<0.001). JSN and meniscal lesions were correlated (r = 0.68, p<0.001). Tibial cartilage lesions were correlated with JSN (r = 0.58, p<0.001).

Conclusions: This radiographic atlas of OA individual features allowed non-invasive in vivo grading and was well correlated with final macroscopic evaluation.