is related to collagen distribution and therefore may allow 3D assessment of collagen distribution in non-calciﬁed AC. In this experimental setting, full staining was achieved in 36 hours. This is a first step towards 3D quantiﬁcation of collagen distribution with in vitro AC samples and in small animal joints.

475 ACCURACY OF COMPUTED TOMOGRAPHY ARTHROGRAPHY TO DETECT CARTILAGE DEFECTS IN THE OVINE KNEE

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Purpose: Naturally occurring cartilage defects of the knee have been described in sheep. The objective of the current study was to assess the accuracy of computed tomography arthrography (CTA) to detect cartilage defects in the ovine knee.

Methods: Animals and imaging: Hindlimbs (n = 28) were collected from crossed Texel ewes euthanatized for reasons other than hind limb lameness. Knees were injected with 20 ml of diluted contrast medium (6 ml of Hexabrix® diluted in 14 ml saline) through a needle placed in the femoro-patellar compartment of the knee, and were ﬂexed and extended 100 times to provide a homogeneous coating of the articular surfaces. The limbs were examined with an Emotion 6 (Siemens). Acquisition protocol was: 130 KV, 80 mAs, pitch 0.4 collimation 0.63 mm and rotation time of the tube 0.6s. Images of 0.63 mm were reconstructed with an increment of 0.3mm. CTA was also performed in two living sheep (4 hindlimbs) under anaesthesia to test the feasibility of the technique. The limb was hold in forced-extension. After imaging, the sheep were euthanized and hindlimbs were collected.

Macroscopic assessment: Knee joints (n = 32) were disarticulated. The distal articular surface of the femur, proximal articular surface of the tibia and articular surface of the patella were examined by gross observation. Macroscopic scoring was performed following OARSI recommendations: score 0 for intact cartilage surface; score 1 for surface roughening; score 2 for deeper defects (ﬁbrillation, ﬁssures) not involving the subchondral bone (SB); score 3 for erosions down to SB (less than 5 mm diameter); score 4 for large erosions down to SB (more than 5 mm diameter).

Histological assessment: Samples were harvested from all sites with macroscopic lesions and from randomly selected macroscopically intact areas. Samples were processed and stained (Toluidine blue). Cartilage structure was scored blindly (from 0 to 10) according to OARSI recommendations.

Analysis of CT scans: Images were analysed blindly by two observers. One observer repeated the blinded assessment one month later to determine intra-observer reproducibility. A score of 0 was given when a sharp and clear contrast of the cartilage was identiﬁed on the cartilage surface without substance loss. A score 1 was deﬁned by a loss of the sharp and smooth contour of the cartilage surface. A score 2 was deﬁned by the penetration of contrast material within at least the superﬁcial half of the cartilage thickness but not to the SB. Score of 3 and 4 were attributed when this penetration reached the SB on respectively less and more than 5 mm diameter.

Statistics: Spearman’s rank order test was used to assess correlation between macroscopic and histological scoring. Sensitivity, speciﬁcity, positive predictive value and negative predictive value were calculated by using gross anatomy as gold standard. They were assessed only for the sites where histopathology conﬁrmed the macroscopic classiﬁcation of defects (for example conﬁrmed that a score 2 defect assessed macroscopically was a partial defect not involving the SB at microscopy, while a score 3 defect was a full thickness defect). Inter-observer and intra-observer agreement were assessed by using Kappa statistics.

Results: 106 histological samples were processed. There was substantial agreement between macroscopic examination and histological scoring for structure (Spearman correlation coefﬁcient 0.75; P < 0.0001); 83 samples (including 40 score 0, 16 score 1, 25 score 2 and 2 score 3 defects) had their macroscopic scoring conﬁrmed by histology. CTA sensitivity and speciﬁcity were respectively 86.12% +/-0.20 and 94.44% +/-0.56 to detect over-all cartilage defects (no defect versus detect). The positive and negative predictive values were 94.50% +/-0.37 and 97.40% +/-0.89. There was substantial agreement between scores at macroscopic examination and those at CTA (Spearman correlation coefﬁcient: 0.84 (observer 1), 0.82 (observer 2-lecture2); P < 0.0001). Inter- and intra-rater agreement was good (Kappa value: 0.67 and 0.93 respectively). Examples of score 2 and 3 defects are shown in Figure 2. In living subjects, two difﬁculties were encountered: breathing in the scanner and limited positioning (Fig. 1). However, all seven score 2 defects present in the living subjects were accurately identiﬁed while two lesions of score 1 were not seen.

Conclusions: CTA is an acceptable non-invasive imaging technique to detect naturally occurring cartilage defects in the ovine knee. This technique can be applied in living animals.

476 BIOCHEMICAL CARTILAGE PROPERTIES IN A SHEEP MODEL - VALIDATION OF ZONAL T2 MAPPING ASSESSMENT

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Purpose: Articular cartilage lesions are a common pathology and spontaneous repair capacity of hyaline cartilage is limited. Hence there is a higher risk of developing osteoarthritis (OA) in the injured joint. The ability to detect this progressive pathology of the joint at an early stage is important for therapy planning. Surgical procedures like matrix associated autologous chondrocyte implantation (MACI) or micro-fracturing (MFX) of cartilage defects are treatment options for cartilage regeneration. In addition to a high-quality follow-up visualization after cartilage repair procedures, MRI can help to understand not only the development of OA but can also evaluate healing steps after cartilage repair procedures non-invasively. T2 mapping with very high resolution at 7T might play an important role in understanding the development of OA and of integration processes after cartilage repair procedures in the future. Especially the zonal (e.g. differentiation in between a deep and superfical cartilage layer) has been shown very high potential in quantitative T2 mapping, nevertheless with still a lack of histological proof. The purpose of this study is to determine the zonal characteristics of articular cartilage (healthy and OA) and cartilage repair tissue of the femoral condyle in a sheep model, using biochemical MRI by means of quantitative T2-mapping.

Methods: Three groups of sheep were enrolled in this study. One group represented healthy cartilage (n = 24), one group represented a model of osteoarthritis of the femoral condyles (post meniscectomy) (n = 22) and one group had induced cartilage defects at the femoral condyle treated by MFX (n = 10). MR scans were achieved at 7T MR whole body system (Magnetom, Siemens Healthcare, Erlangen, Germany) using a twenty-eight-channel transmit/receive knee array coil. T2 relaxation maps were measured with ultra-high resolution sagittal multi-echo T2-lecture2).