

## Cartilage Diagnosis based on MRI Diffusion Imaging: Correlation with gross pathology and histology in the femoral head

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**Introduction:** Diffusion Imaging is recently used as potential method for detection of macromolecular composition and structure of articular cartilage in osteoarthritis and for monitoring of cartilage repair procedures [1, 2]. Steady-State Diffusion Weighted Imaging (SS-DWI) is described and quantified for in vivo cartilage imaging of the knee [3]. Aim of the presenting study was to assess the diagnostic quality of SS-DWI in the hip by comparison with intraoperative findings and histology of the femoral head in patients with severe osteoarthritis.

**Material und Methods:** 6 Patients with severe osteoarthritis of the hip and indication for total hip replacement underwent in vivo 3T MRI (Siemens Magnetom Trio) with cartilage sensitive isotropic 3D-DESS (TR = 15.6 ms, TE = 4.5 ms, resolution 0.7x0.7x0.7 mm<sup>3</sup>) and a diffusion weighted 3D-PSIF sequence (resolution 0.6x0.6x1.2 mm<sup>3</sup> diffusion encoding gradient moment 45 [mT/m\*ms], 75 [mT/m\*ms], three orthogonal orientations) in the contact pressure area of the affected hip. For the macroscopic classification the resected femoral head was divided in 8 anatomical portions correlating to the femoral neck position and analysed based on the criteria described by Outerbridge et al [4]. The resected femoral head was marked with 4 pins and imaged with the same MRI sequences but higher resolution (3D-DESS and diffusion weighted 3D\_PSIF both 0.4x0.4x0.4 mm<sup>3</sup>) on the day of resection. Next the resected femoral head was fixed and semi thick slices of 0.3 mm were made with toluidin blue staining. The histological data was staged according to the Mankin histopathological scale [5] and registered by the pin location to the MRI data. For the initial comparison of diffusion weighted images with histology, any effects of anisotropic diffusion were disregarded using the Trace weighted diffusion images.

**Results:** We found correlation of macroscopic changes to MRI in 3D-DESS and SS-DWI for swelling of the cartilage and severe grade of OA.

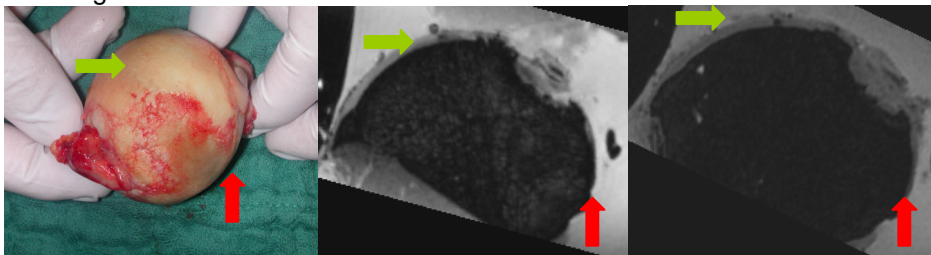




Fig.1: Correlation of cartilage swelling  and  severe osteoarthritic changes to SS-DWI and 3D-DESS

For histological changes in the articular cartilage we found specific alterations in signal intensity for 3D-DESS and the Trace weighted diffusion images. For the 3D-DESS we found correlation to the amount of proteoglycans represented by the toluidin blue staining. The SS\_DWI did not correlate directly to the staining and the cartilage thickness, but to the overall matrix structure [6].



Fig.2: Correlation of structural changes to SS-DWI

**Discussion and Conclusion:** Our preliminary results show the potential for SS-DWI in detection of structural defects in articular cartilage. It was possible to correlate macroscopic and histological findings to SS-DWI and use a non-quantitative approach for validation of the method. In an ongoing study we correlate our results to the in-vivo measurements of the same patients.

### References:

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