Biochemical evaluation of articular cartilage in patients with osteochondrosis dissecans by means of quantitative T2-mapping at 3 Tesla MRI

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Purpose

The purpose of our study was to assess quantitative MRI techniques in patients with OCD and in healthy volunteers as a control group. The focus was to evaluate quantitative T2 relaxation time values in vivo in patients suffering from OCD in the talocrural joint[1] compared to healthy volunteers at 3.0 Tesla MRI.

Methods and Materials

Patients and volunteers:

Ten patients with OCD (mean age: 27.3 years (range:14-33), 2 female, 8 men) and 9 healthy age matched volunteers (mean age 28.3 years (range: 15-49), 3 female, 6 men) without known histories of musculoskeletal disease, trauma or pain were included in this study. The OCD was diagnosed by standard radiographs and/or standard MR examinations in 5 patients on the right and in 5 patients on the left talocrural joint. In all cases the defect was on the medial side of the talar dome. Two Patients were examined twice and one patient three times in their further follow up to examine the course of disease.

In the volunteer group the left talocrural joint was examined 7 times, the right 4 times. Two healthy volunteers had both of their ankle joints examined.

MR imaging protocol:

MRI was performed at a 3.0 Tesla whole body scanner using a flexible multi-element coil consisting of two parts with four receive only coil-elements. Patients were placed consistently in a supine position with the foot at a 90° angle relative to the lower leg to minimize potential magic angle effects.

To avoid possible differences in T2 relaxation times due to loading/ weight bearing of cartilage prior to the examination, MRI was performed after at least 20 minutes of rest. After localising, MR sequences for morphological imaging and location of anatomical site of the lesion were performed. Therefore we used a 3D-TrueFISP sequence and a proton-density fast spin echo (PD-FSE) sequence. For biochemical analysis of the cartilage quantitative T2 mapping was performed[2-4].

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<th>PD</th>
<th>3D-True Fisp</th>
<th>T2</th>
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<tbody>
<tr>
<td>TE</td>
<td>26ms</td>
<td>3.82ms</td>
<td>13.8-82.8ms</td>
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Image analysis:

In patients, suffering from OCD, based on the morphological images provided by the PD-FSE and 3D TrueFISP sequence, 2-3 slices, covering the osteochondral defect were selected on the T2 maps. Within each selected slice a region of interest (ROI) was manually drawn into the cartilage layer overlying the defect at the level of normal hyaline cartilage. In the same talocrural joint of the individual patients a region of morphological normal appearing cartilage, at least 2 slices away from the OCD and confirmed as healthy by the PD-FSE and TrueFisp sequence was chosen as an intraindividual reference.

Furthermore morphological and biochemical images were obtained in healthy volunteers as a reference to assure, that the whole cartilage layer of the talo-crural joint revealed no cartilage defects. Three ROIs were positioned on the medial side of the talar dome, where OCD most often occurs.

Statistical analysis:

For statistical evaluation, mean T2 values were calculated within every subject for the OCD-site and the healthy cartilage control site in patients as well as for the cartilage control site in healthy volunteers acting as control group.

Statistical evaluation was performed to compare T2 relaxation times obtained from patients and healthy volunteers using a student´s t-test.

For statistical evaluation SPSS for Windows was used, and a p value less than 0.05 was considered statistically significant.

Results
In patients, the ROIs for the OCD and control site had a mean size of 161 (range 91 - 585) and 147 (range 95-502) pixels on T2 maps respectively. In the control group of healthy volunteers the mean size of the ROIs was 126 pixels (range 103-206) on T2 slices.

**OCD vs. cartilage control site in patients**

The mean T2 value for the OCD-site in patients was 44.2 ms (SD 6.6). ROIs analysis in control cartilage in patients revealed a mean relaxation time of 31.4 ms (SD 3.6) for T2.

Performing a paired student's t-test, a significant difference between the OCD site and the control site within the same patients was found for T2 (p < 0.01).

**OCD vs. cartilage control site in volunteers**

The mean T2 value for the control cartilage in healthy volunteers was 29.8 ms (SD 5.7).

Performing an unpaired t-test, a significant difference in T2 (p < 0.01) values for the cartilage layer of healthy volunteers versus patients with OCD could be seen.

**Cartilage control site in patients vs. cartilage control site in volunteers**

A comparison of the cartilage layer in the healthy reference group compared to the cartilage areas which appeared morphological normal in patients with OCD, revealed no significant differences for T2 (p = 0.842).

A visual presentation is given in Figures 1+2.

**Images for this section:**
Fig. 1: Fig1.: Showing mean T2-values for patients suffering from OCD, patients reference cartilage and reference cartilage of healthy volunteers. A significant difference between OCD and control cartilage can be seen.
Fig. 2: PD and T2-map of a patient with OCD. Increased T2 values in the cartilage layer above the defect can be seen
Conclusion

Our collected data suggest that, although the articular cartilage above an OCD often seems morphologically to be intact, changes in the structural integrity of the collagen matrix and in the cartilage water content have already taken place. Thus, measuring the mean T2 value could be a promising, non-invasive diagnostic method for the definition of the biochemical condition of the articular cartilage above the OCD in the talocrural joint. It could also be a powerful tool in the monitoring of OCD after surgical interventions.

References


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