COMPARISON OF CARTILAGE THICKNESS AND RADIOLOGIC GRADE OF TIBIOFEMORAL OSTEOARTHRITIS

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INTRODUCTION
Osteoarthritis (OA) is characterized by progressive cartilage degeneration in the load-bearing surface of diarthrodial joints eventually leading to cartilage breakdown. OA severity is usually graded according to the Kellgren and Lawrence scale (radiographs) or the modified Outerbridge classification (MRI), both ranging from 0 (no OA) to 4. A common way to track the progression of OA is to measure the joint space width (JSW) from radiograph images. Typically these measurements are performed by hand and subject to a large intra and inter user variability. The purpose of this study was to correlate the clinical grade of OA with JSW obtained from MRI images using a semi automated algorithm.

METHODS

Subjects: 142 patients (106 w,36 m) with a mean age of 59 (range 31-81) had their tibiofemoral joint graded for OA and underwent MRI scanning of their knees. 17 asymptomatic subjects (9w, 8m) with a mean age of 34 (range 22-58) were recruited for the algorithm validation. A board-certified musculoskeletal radiologist graded the OA of all patients according to Kellgren and Lawrence scale.

Imaging protocol: All research participants were imaged in the sagittal plane using a GE Signa Excite 1.5T MRI scanner with a spiral fast SPGR sequence. All subjects were studied supine with a pad under their knees to ensure a flexion angle of approximately 20 degrees. Manual measurements were performed on an Advantage Workstation v4.0.

Computer algorithm: Inter and intra-user variability was assessed by measuring the minimum bone to bone distance on the asymptomatic subjects twice by one user and once by a second user. These measurements were compared with those obtained manually on the same slice in each compartment previously identified by the algorithm as the one showing the minimum thickness, thus minimizing variability related to the visual choice of the slice to measure.

Analysis: Repeatability of the measurements was evaluated by the paired difference between measurements and the repeatability coefficient [1]. An ANOVA was used with a Student-Newman-Kuels post-hoc test to determine if there were differences in JSW as a function of OA grade.

RESULTS
The computer algorithm was quicker and more reproducible than the manual method (Tables 1 & 2). The automated method obtained a smaller JSW compared to the manual method (Tables 1 & 2). The computer algorithm was quicker and more reproducible than the manual method (Tables 1 & 2). The radiographic grade of OA was inversely associated with the JSW (Figure 1). The JSW did not change significantly between normal and grade 1. There were significant differences in JSW between all other grades of OA.

DISCUSSION
This study has shown that there is a significant non-linear decrease in JSW measured with MRI and the radiologic grade of tibiofemoral OA. The similarity in JSW between grade 0 and grade 1 might be related to changes in water content of the cartilage. With the progression of OA, the cartilage loses the ability to maintain it’s structure and the JSW decreases. [2]

The purpose of MRI in the evaluation of degenerative changes of the knee joint is still in the early stages of development. This study has shown that even with non-weight bearing images there is a relation between radiologic grade of tibiofemoral OA and JSW. These findings are similar to other recent studies that have shown that there is a strong association between tibial cartilage volume and grade of OA [3, 4].

Development of treatments for early OA is limited by a lack of non-invasive methods that are reproducible and accurate. These data document a semi-automated method that can be used to objectively quantify the early stages of OA in a clinical setting. This will be important method for documentation of changes in clinical trials.

REFERENCES

ACKNOWLEDGEMENT
Support by NIH grant R01 AR48768

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Table 1: Intra-user reproducibility

<table>
<thead>
<tr>
<th>Technique</th>
<th>Mean±SD (mm)</th>
<th>Absolute mean (mm)</th>
<th>Repeatability coefficient (mm)</th>
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<td>Manual</td>
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Table 2: Inter-user reproducibility

<table>
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<td>Manual</td>
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Figure 1. Boxplot of tibial cartilage thickness (mm) versus the corresponding radiologic grade of OA. Boxes represent 25-75th percentile. Horizontal line represents median. Solid circle represent mean.