CORRELATION BETWEEN CHANGES IN RADIOGRAPHIC JOINT SPACE WIDTH AND MRI CARTILAGE THICKNESS IN THE APPROACH COHORT

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Purpose

In patients with knee osteoarthritis (OA), joint space width (JSW) measured on weight-bearing radiographs represents several (tissue) characteristics and is often used as a surrogate measure for cartilage thickness.
However, changes in JSW often show a weak correlation with changes in cartilage thickness as measured on non-weight-bearing MRI. A previous study suggested that the difference in weight-bearing between the two techniques (partly) causes this weak correlation.
The APPROACH cohort was specifically designed to include patients with knees likely to show structural progression over a two-year follow-up period.

The objective was to investigate the correlation between changes in radiographic JSW and MRI cartilage thickness using knees of patients from the APPROACH cohort, and secondly to explore the influence of different parameters that could contribute to weight-bearing related differences in JSW and cartilage thickness changes.

Methods

- In APPROACH, 297 patients were included. In the current study, only patients with predominantly medial OA (determined on radiographs) were included. PA radiographs and 1.5T or 3T MRI scans were acquired at baseline, six months, one year and two years.
- The mean medial JSW and minimum JSW (mm) were measured from radiographs using KIDA software. MRI-based cartilage thickness of the medial tibiofemoral compartment (mm) was measured from manual, quality-controlled cartilage segmentations (Chondrometrics). Only patients with both measurements at baseline, 6 months and/or 1 year, and at two years, were included in the current study.
- Linear regression was used to determine the change over two years. Pearson correlations were calculated between the changes in cartilage thickness and in mean medial and minimum JSW.
- The influence of cartilage quality (3 groups: lowest, middle, or highest T2 times), meniscal extrusion (MOAKS medial or anterior extrusion >0), and pain-induced (>2 NRS points higher pain in index knee than contralateral knee) and body mass index (BMI)-induced (healthy BMI<25, overweight 25<BMI<30 or obese ≥30) (un)loading on the correlations was investigated.
- Correlations between changes in cartilage thickness and JSW were compared between all mentioned category groups. Modification of the slope by category was investigating using interaction terms in linear regression models. These models (using standardized variables) were also used to compare Pearson R correlations between JSW and cartilage thickness changes.
- If there was a statistically significant difference between groups in correlation or slope (interaction term p<0.05), correlations were analyzed separately per group, and visualized in correlation graphs with regression line with coefficients (B).

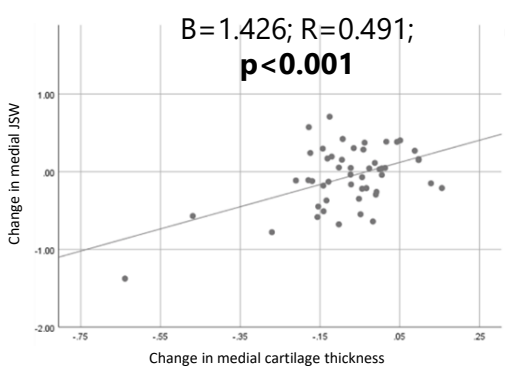
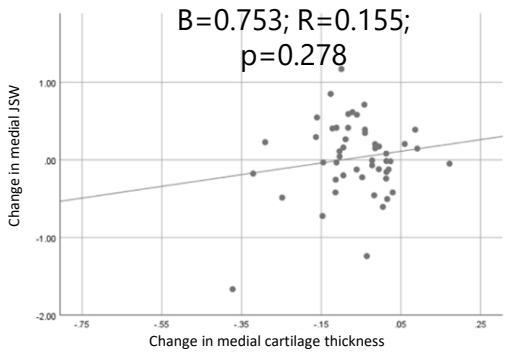
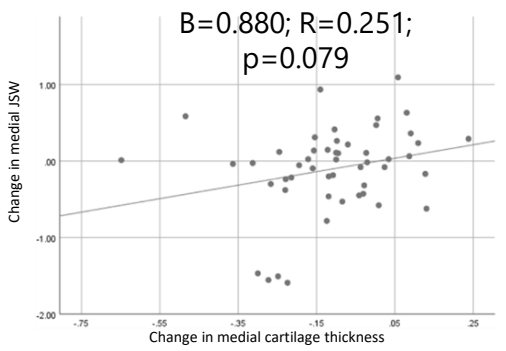
T2 times group	Correlation Δmedial cartilage thickness and Δmedial JSW
Lowest T2 times; n=50	
Medium T2 times; n=51	
Highest T2 times; n=50	

Figure 1: Correlations of medial cartilage thickness change with medial JSW for the different groups based on T2 times. B = slope; R = Pearson correlation; statistically significant p-values (p<0.05) are in bold. Correlations of medial cartilage thickness change with minimum JSW were similar. Of note, the one center that used 1.5T scans showed relatively high T2 times; excluding this center and re-dividing groups resulted in similar effects although non-significant, with only patients with highest T2 values (lowest quality cartilage) not showing significant correlations (both p>0.29 and R<0.18, other groups all p<0.037 and R>0.33).

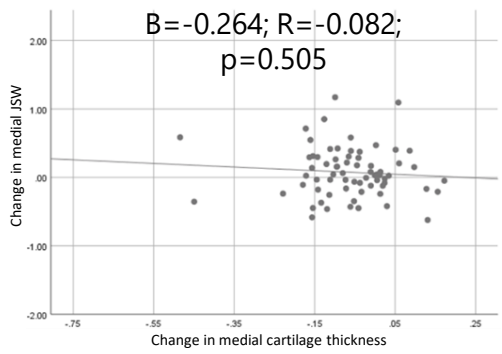
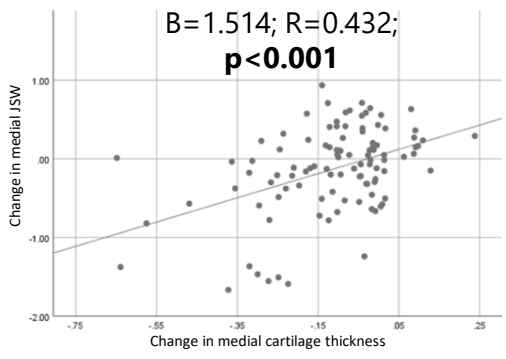
Meniscal extrusion group	Correlation Δmedial cartilage thickness and Δmedial JSW
Without extrusion; n=69	
With extrusion; n=104	

Figure 2: Correlations of medial cartilage thickness change with medial JSW for the different groups based on meniscal extrusion. B = slope; R = Pearson correlation; statistically significant p-values (p<0.05) are in bold. Correlations of medial cartilage thickness change with minimum JSW were similar.

Results

- The required data was available of 178 medial OA patients. An average decrease in medial JSW (-0.06 mm; SD 0.49), minimum JSW (-0.07 mm; SD 0.56) and cartilage thickness (-0.09 mm; SD 0.14) was seen.
- Correlations between changes in cartilage thickness and medial (R=0.34; p<0.001) and minimum (R=0.22; p=0.003) JSW were statistically significant but weak.
- There was a statistically significant difference in correlation of cartilage thickness with minimum JSW between T2 time categories, and in correlation and slope with medial JSW for meniscal extrusion, but not for pain and BMI (all p>0.2). Only the group of patients with the lowest T2 times (**Figure 1**) and with meniscal extrusion (**Figure 2**) showed significant and mostly moderate correlations.

Conclusions

Potential pain-induced unloading and BMI-induced extra loading during weight-bearing radiograph acquisition do not seem to contribute to differences in the relation between JSW and cartilage thickness. Patients with lower T2 times show a higher correlation, indicating that healthier cartilage is potentially less influenced by compression during weight-bearing. Patients with meniscal extrusion show better correlations as well, as JSW is influenced by the meniscus as well and meniscal presence seems to disturb the relation between weight-bearing JSW and non-weight-bearing cartilage thickness changes. Future research should include a combination of factors to detect how weight-bearing JSW represents cartilage thickness and quality, meniscal extrusion, and other possible factors, including radiographic positioning. Loaded MRI studies would be of value as well.

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