Introduction:

Hypertrophic repair of articular cartilage is a phenomenon that has been described in animal models of knee osteoarthritis and in humans [1]. In serial radiographs of the knee with OA, hypertrophic repair may present as widening of the joint space (WJS). Large variability in medial compartment joint space narrowing (JSN), in relation to the mean JSN, in previous studies of radiographic progression of knee OA [2-5] may reflect hypertrophic repair, but also may result from lateral JSN, changes in the alignment of the medial tibial plateau (MTP) with the x-ray beam and variable magnification in serial x-ray images. To document the relative frequency of possible causes of WJS, we examined pairs of conventional standing anteroposterior (AP) knee radiographs from OA research cohorts in four locations in the United States and England.

Methods:

Selection of Radiographs. Data for this study were derived from standing AP knee radiographs of 370 subjects who participated in longitudinal studies in which the radiographic progression of knee OA was documented in serial examinations obtained at an interval of 2–3 years. Two were population-based cohorts from the United States; 2 were clinical OA cohorts drawn from patient populations in England. To be eligible for this analysis, subjects were required to have definite bilateral or unilateral knee OA (i.e., grade II-IV OA severity by Kellgren and Lawrence criteria [6]) and baseline joint space width (WJS) >0 mm, a repeat radiograph taken 2-3 years later, and no radiographic evidence of intercurrent knee surgery.

 Procedures. All identifying information and dates of examinations were masked, and radiographs from each location were ordered randomly. Radiographic features of OA (osteophytes, sclerosis, cysts and JSN) in the medial and lateral compartments of each knee were graded for severity (0 to 3 scale) by consensus of two readers, using a radiographic atlas. The adequacy of radioanatomic positioning of each knee also was graded by consensus of the same readers according to criteria developed by Buckland-Wright [7]. Alignment of the MTP and x-ray beam was considered satisfactory if the anterior and posterior margins of the MTP were superimposed ±1 mm. Knee rotation was considered satisfactory if the tibial spines were centered below the femoral notch (i.e., the spines were displaced to either side of the apex of the intercondylar groove of the femur).

Measurement of JSW. Minimum medial JSW was measured manually with a screw-adjustable calipers and x10 magnifying lens fitted with a 10 mm graticule (>0.2 mm). Intra-observer reproducibility of JSW measurements was determined in a random sample of 20 knees, in which JSW was measured 4 times, on consecutive days, by an investigator who was blind to any of the previous measurements. The standard error of repeated measurements in this sample (i.e., the mean of within-subject standard deviations (SD) of JSW in each of the 20 knees) was 0.20 mm and the CV was 4.4%.

Results:

Evaluation of baseline radiographs yielded 525 knees with JSW >0 mm at baseline. Of these, significant WJS in the medial compartment (i.e., 30.5 mm or >2 standard errors of measurement) was found in 119 knees (23%). A breakdown of potential explanatory findings in these knees is presented in the table below.

<table>
<thead>
<tr>
<th>Potential Explanatory Findings</th>
<th>N (%) of Knees With Medial WJS &gt;0.5 mm</th>
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<tbody>
<tr>
<td>Progression of lateral compartment OA</td>
<td>29 (24)</td>
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<tr>
<td>Lateral JSN (N = 6)</td>
<td>18 (14)</td>
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<tr>
<td>Growth of lateral osteophyte (N = 23)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Change in alignment of the MTP</td>
<td>41 (34)</td>
</tr>
<tr>
<td>None</td>
<td>61 (51)</td>
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</tbody>
</table>

Progression of one or more radiographic features of knee OA in the lateral compartment was found in 29 knees with medial WJS >0.5 mm. However, in only 6 of these knees was lateral compartment JSN observed. The remaining 23 knees exhibiting lateral progression of knee OA showed only growth of osteophytes. In contrast, 41 (34%) of the cases of medial WJS came from paired images showing no lateral JSN, but in which fortuitous MTP alignment observed in one image was not replicated in the other. WJS in the remainder (47 knees) could not be attributed to a specific cause. Notably, in 66 OA knees with satisfactory MTP alignment in both x-ray images, none exhibited significant lateral JSN.

Conclusion:

WJS in the medial compartment is not uncommon in serial conventional radiographs of patients with knee OA. Among knees exhibiting medial WJS, changes in alignment of the MTP and x-ray beam are more frequently noted than is progression of lateral compartment OA. MTP alignment in serial x-ray images of OA knees reduces the magnitude of WJS to within the limits of measurement error. If hypertrophic repair of articular cartilage occurred in our patients, the magnitude of articular cartilage thickening was less than that of measurement error.

References


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