Introduction: Prospects for more reproducible measurement of medial tibiofemoral joint space width (JSW) and improved sensitivity to joint space narrowing (JSN) in knee OA have increased since the recent development by Buckland-Wright and colleagues of a highly standardized set of procedures for semiflexed anteroposterior (AP) knee radiography [1] and automated measurement of tibiofemoral JSW with specialized edge-detection computer software [2]. Buckland-Wright et al [3] have reported that, when imaged and measured by their procedures, JSW in digitized images of OA knees positioned repeatedly by the same technician can be measured with a high degree of precision, i.e., coefficient of variation (CV) = 5.5%.

Whether this procedure can be disseminated to the broader research community and performed with similar reproducibility within other clinical radiology units is currently unknown. Therefore, we trained 5 teams of clinical radiology technologists to obtain a semiflexed AP view of the knee according to the procedures of Buckland-Wright et al [1], following which we arranged for them to perform and repeat the examination on a sample of subjects with and without knee OA. We herein describe the degree to which the precision of automated measurements of tibiofemoral JSW is affected by subject characteristics (e.g., radiographic severity of knee OA, body weight), by technical features apparent in the semiflexed AP knee radiographs (e.g., proper rotation and/or flexion of the knee) and by variability in the positioning of the knee in examinations repeated within radiology units.

METHODS

Subjects: Forty-four men and women, age 45 years and older, were studied. Thirty-four had mild-to-moderate OA of the medial tibiofemoral compartment, as determined by the presence of a definite osteophyte in one or both knees (i.e., grade 2 or 3 OA by Kellgren and Lawrence [K&L] criteria [4]) and JSW >2 mm as measured with calipers (+ 0.05 mm) on the extended view radiograph. Ten obese subjects with bilateral normal knees (i.e., Grade 0 or Grade 1 OA severity by Kellgren and Lawrence knee OA, body weight), by technical features apparent in the semiflexed AP knee radiographs (e.g., proper rotation and/or flexion of the knee) and by variability in the positioning of the knee in examinations repeated within radiology units.

RESULTS

Radiographic images using a Lumiscan 75 laser film digitizer (Lumisys, Inc.; Sunnyvale, CA). Minimum medial tibiofemoral JSW was measured using JSW computer software [2].

Statistical Analysis: Factors affecting the reproducibility of JSW measurements were evaluated with a series of mixed effects analysis of variance (ANOVA) models. Radiology Unit was included as a random effect. Statistical Analysis: Factors affecting the reproducibility of JSW measurements were evaluated with a series of mixed effects analysis of variance (ANOVA) models. Radiology Unit was included as a random effect. Statistical Analysis: Factors affecting the reproducibility of JSW measurements were evaluated with a series of mixed effects analysis of variance (ANOVA) models. Radiology Unit was included as a random effect. Statistical Analysis: Factors affecting the reproducibility of JSW measurements were evaluated with a series of mixed effects analysis of variance (ANOVA) models. Radiology Unit was included as a random effect.

Knee Flexion/Rotation

<table>
<thead>
<tr>
<th>N of Knees</th>
<th>ICC</th>
<th>SEM (mm)</th>
<th>CV (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both images satisfactory</td>
<td>76</td>
<td>0.92</td>
<td>0.25</td>
</tr>
<tr>
<td>One image satisfactory</td>
<td>49</td>
<td>0.98</td>
<td>0.31</td>
</tr>
<tr>
<td>Neither image satisfactory</td>
<td>49</td>
<td>0.84</td>
<td>0.40</td>
</tr>
</tbody>
</table>

DISCUSSION

These data confirm the validity of technical standards for knee flexion and rotation for the semiflexed AP protocol. When the semiflexed AP exam was performed with proper knee flexion and rotation, precision of JSW measurements rivaled that demonstrated in the radiology unit in which the protocol was developed [3]. However, despite training and ongoing self-monitoring of technical quality, technologists often failed to recognize flaws in their technique. Future field applications of this protocol should utilize an independent appraisal of technical quality and require immediate repeat of flawed exams. In studies of the natural history of OA progression and clinical trials of disease-modifying OA drugs, failure to eliminate technical flaws will result in greatly reduced power (requiring longer duration and/or larger sample size) to detect true narrowing of tibiofemoral JSW.

References


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FIELD TEST OF THE SEMIFLEXED ANTEROPOSTERIOR KNEE VIEW: REPRODUCIBILITY OF MEDIAL TIBIOFEMORAL JOINT SPACE WIDTH

*+Mazzuca, S A, Brandt, K.D. **Buckland-Wright, J.C., Backwelter, K.A., Katz, B.P.
*+Indiana University Multipurpose Arthritis and Musculoskeletal Diseases Center, +541 Clinical Drive, Room 492, Indianapolis, IN 46202-5103
Telephone: (317) 274-6876, Fax: (317) 274-7792; e-mail: smazzuca@iu.edu


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