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IMPROVED PRECISION IN THE QUANTIFICATION OF KNEE ALIGNMENT ANGLE

B Goker1, JA Block2
1Medicine/Rheumatology, Gazi University Medical School, Ankara, Turkey; 2Section of Rheumatology, Rush University Medical Center, Chicago, IL

The knee alignment angle, a measure of mechanical axis, is highly associated with severity and progression of knee OA. Quantification using previously defined methodologies often results in unacceptable reproducibility due to poor definition of landmarks and to imprecise measurement techniques. Here, we describe and validate a reproducible highly sensitive method to quantify knee alignment angles, using standard full-limb mechanical axis radiographs and freely available public-access software.

Methods: 28 knees of 14 patients with symptomatic knee OA (Kellgren-Lawrence grade 2-3, pain on ambulation > 30 mm on a 100 mm visual analog scale) were evaluated with full-limb radiography. The knee alignment angle, defined as the angle formed by the mechanical axis of the femur and that of the tibia, was determined using a standard manual technique and compared to the digital method described here. All assessments were performed blinded and in duplicate on separate days. The standard method used a radiographic goniometer after manual marking of the landmarks. This was compared with the novel method, wherein landmarks were designated digitally using Image J software (US NIH, Bethesda, MD, http://rsb.info.nih.gov/ij/). The femoral mechanical axis was marked as the line between the center of the femoral head (identified through generation of a close-fit circle) and the center of the intercondylar notch; the tibial axis was marked as a line between the digitally-determined midpoint of the tibial plateau and the center of the tibial plafond (determined similarly). The angle formed by these two lines is the knee alignment angle. Limits of agreement analyses were performed by the method of Bland and Altman (Lancet, '86;1 (8476):307).

Results: There was excellent agreement between the manual and digital methods (R²=0.94). For the group overall, the difference in measured knee alignment angle between the methods was 0.21 ± 0.59 degrees (mean ± SD), with a maximum of 1.18° and limits of agreement of +1.39° to -0.97°. However, the precision obtained with the digital method was far superior to the manual method. With the Standard method, the limits of agreement were +1.68° to -1.55°, yielding a minimum detectable change of approximately 1.6°. In contrast, the Digital method provided limits of agreement of +0.41° to -0.35°, resulting in a minimum detectable change of only 0.4°.

Conclusion: Knee alignment angle is an important parameter both prognostically and for biomechanical research in OA of the knee. Standard methodologies have margins of error that typically exceed 2°, yet differences of a single degree may have significant adverse mechanical consequences over time. Here, we have described a method to reliably determine mechanical axis with precision that permits detection of differences of less than one degree. Moreover, this method is simple, convenient, and employs public access software. We suggest that investigators interested in biomechanical mediators of knee OA employ improved methodology when determining mechanical axes in the future.

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REPRODUCIBILITY AND SENSITIVITY TO CHANGE OF VARIOUS METHODS OF JOINT SPACE WIDTH (JSW) MEASUREMENTS IN OSTEOARTHRITIS OF THE HIP (OA): A DOUBLE READING OF THREE DIFFERENT RADIOGRAPHIC VIEWS TAKEN WITHIN A 3-YEAR TIME-INTERVAL

E Maheu1, C Cadet2, M Marty2, M Dougdos1, S Ghabri3, I Kerloch2, B Mazières5, TD Spector7, E Vignon8, MG Lequesne9
1Rheumatology Unit, St Antoine Hospital, Paris, France; 2None, None, Paris, France; 3Clinica and Statistica, Issey Les Moulinaux, France; 4Rheumatology Institute, Cochin Hospital, Paris, France; 5Expanscience Labs, Courbevoie, France; 6Service Rhumatologie, Rangueil Hospital, Toulouse, France; 7Twin Research Unit, St Thomas’s Hospital, London, United Kingdom; 8Service Rhumatologie, Lyon-Sud Hospital, Lyon, France; 9Service Rhumatologie, Leopold Bellan Hospital, Paris, France

Background: Joint space width (JSW) and Joint Space Narrowing (JSN) measurements on radiographs are currently the best way to assess disease severity or progression in hip osteoarthritis (OA). Yet, we lack data regarding the most accurate and sensitive method to perform these measurements.

Objective: The aim of our study was to assess which radiograph and what number of readers provides the highest accuracy for JSW and JSN measurements.

Material and methods: 50 pairs of radiographs taken 3 years apart were obtained from patients included in a structure-modification trial in hip OA. Three radiographs were performed in standing position: pelvis; target hip antero-posterior (AP) view; oblique view. Two trained readers, blinded to each other's results, time sequence and treatment, read twice (interval > 15 days), the 6 X-rays gathered for each patient, using a 0.1 mm graduated magnifying glass. X-rays were randomly coded for each reading. Inter-, intra-reader cross-sectional (M0 and M36) and longitudinal (M0-M36) reproducibilities were assessed by intraclass coefficient (ICC) and Bland-Altman method with 95% confidence interval (CI) for readers 1, 2 and mean of both readers. Sensitivity to change was estimated by the Standardised Response Mean (SRM; Δ/SD of Δ) on M0-M36 changes.

Results: For inter-observer reliability on M0-M36 changes, ICC [CI] were 0.79 [0.65-0.88] for pelvic view, 0.87 [0.78-0.93] for hip AP view, and 0.86 [0.76-0.92] for oblique view. Intra-observer reliability ICC values were 0.81 [0.69-0.89] for observer 1, 0.97 [0.95-0.98] for observer 2 for pelvic view, 0.87 [0.78-0.92] and 0.97 [0.96-0.99] respectively for hip AP view, 0.73 [0.57-0.84] and 0.93 [0.88-0.96] respectively for the oblique view. SRM values were 0.61 (observer 1) and 0.82 (observer 2) on pelvic view, 0.64 and 0.75 respectively on hip AP view, 0.77 and 0.70 respectively on oblique view.

Conclusion: All 3 views were accurate in measuring JSW and JSN. According to the best reader, the pelvic performed slightly better. Both readers showed a high precision with SRM ≥ 0.6 for JSN assessment over 3 years. Selecting a single reader was the most accurate method offering a precision of 0.3 mm in this study. When choosing this cut-off, 50% of patients were classified as ‘progressors’.