

Artificial intelligence–assisted radiographic assessment of knee osteoarthritis

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Relevance: Knee osteoarthritis (KOA) is one of the most prevalent musculoskeletal disorders and a major cause of pain, reduced mobility, and disability among adults worldwide. Conventional radiography remains the primary imaging modality for diagnosing and grading KOA; however, radiographic interpretation is subject to interobserver variability and may be influenced by the experience of the radiologist. Recent advances in artificial intelligence (AI), particularly deep learning algorithms, have demonstrated promising results in the automated detection and grading of osteoarthritic changes on radiographs. The integration of AI into radiological practice may improve diagnostic consistency, reduce reporting time, and facilitate early disease detection. Therefore, evaluating the effectiveness of AI-assisted radiographic assessment of knee osteoarthritis is of significant clinical and scientific interest.

61

Objective: to evaluate the diagnostic performance of an artificial intelligence-based system in the radiographic assessment and grading of knee osteoarthritis compared with expert radiologist interpretation.

Materials and Methods: A retrospective study was conducted on 128 patients who underwent standard weight-bearing anteroposterior and lateral knee radiography due to chronic knee pain or suspected osteoarthritis. The study included 74 women (57.8%) and 54 men (42.2%), with a mean age of 61.3 ± 8.7 years. All radiographs were independently assessed by two experienced musculoskeletal radiologists according to the Kellgren–Lawrence (K-L) grading system. Subsequently, the images were analyzed using a convolutional neural network (CNN)-based artificial intelligence platform trained to detect osteoarthritic changes and automatically assign K-L grades. Statistical analysis was performed using SPSS 28.0 software. Agreement between AI and radiologist assessments was evaluated using Cohen's kappa coefficient (κ). Differences in grading distributions were analyzed using the Chi-square (χ^2) test. Sensitivity, specificity, F1-score, and overall accuracy were calculated. A p-value < 0.05 was considered statistically significant.

Results: Among the 128 examined patients, radiologists diagnosed knee osteoarthritis in 102 cases (79.7%). According to expert assessment, K-L Grade I was observed in 18 patients (14.1%), Grade II in 37 patients (28.9%), Grade III in

31 patients (24.2%), and Grade IV in 16 patients (12.5%). The AI system correctly identified osteoarthritic changes in 98 of 102 positive cases and correctly classified 22 of 26 non-osteoarthritic knees. The sensitivity, specificity, and overall accuracy of the AI model were 96.1%, 84.6%, and 93.8%, respectively. Agreement between AI-generated grades and radiologist evaluations was substantial ($\kappa = 0.82$, $p < 0.001$). The highest classification accuracy was observed for advanced osteoarthritis (K-L Grades III–IV), reaching 95.4%, whereas early-stage disease (K-L Grade I) demonstrated a lower accuracy of 83.3%.

The mean interpretation time per examination was significantly reduced from 4.8 ± 1.2 minutes for radiologists to 0.9 ± 0.3 minutes using the AI system ($p < 0.001$). Furthermore, AI-assisted assessment decreased interobserver variability by 28.4% compared with conventional radiographic interpretation.

Conclusion: Artificial intelligence demonstrates high diagnostic accuracy in the radiographic assessment of knee osteoarthritis and shows strong agreement with expert radiologist evaluations. AI-based systems are particularly effective in detecting moderate and advanced osteoarthritic changes while substantially reducing image interpretation time. The integration of artificial intelligence into routine radiological practice may enhance diagnostic efficiency, improve standardization of osteoarthritis grading, and support clinical decision-making.

Keywords: knee osteoarthritis, artificial intelligence, deep learning, radiography, Kellgren–Lawrence grading, diagnostic accuracy, musculoskeletal imaging, machine learning, radiology.