# Osteoarthritis: Current Role of Imaging

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**KEYWORDS**

• Osteoarthritis • Magnetic resonance imaging • Radiography
• Knee • Computed tomography • Nuclear medicine
• Arthrography

Osteoarthritis (OA) is the most prevalent joint disease and is increasingly common in the aging population of Western society and has a major health economic impact. Despite surgery and symptom-oriented approaches there still is no efficient treatment for this complex and heterogeneous disease. Conventional radiography has played an important role in the past in confirming the diagnosis of OA and demonstrating late bony changes and joint space narrowing (JSN); it has been applied as an endpoint for disease progression in clinical trials. OA is a disease, however, of the whole joint, including cartilage, bone, and intra- and periarticular soft tissues. Magnetic resonance imaging (MRI), with its capability of visualizing bone, cartilage, and soft tissues, has become the method of choice in large research endeavors and may become important for individualized treatment planning in the future. This article focuses on radiography and MRI and gives insight into other modalities, such as ultrasound (US), scintigraphy, CT, and CT arthrography. Their role in the diagnosis, follow-up, and research in OA is discussed.

A version of this article originally appeared in the 34:3 issue of the *Rheumatic Disease Clinics of North America*.

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Med Clin N Am 93 (2009) 101–126
doi:10.1016/j.mcna.2008.08.003 **medical.theclinics.com**

## CONVENTIONAL RADIOGRAPHY

Conventional radiography is the simplest and least expensive imaging method for assessing knee OA. Radiography is able to directly visualize osseous features of OA, including marginal osteophytes (OPs), subchondral sclerosis, and subchondral cysts, but assessment of joint space width (JSW) provides only an indirect estimate of cartilage thickness and meniscal integrity. Radiography is used in clinical practice in patients to confirm the diagnosis of OA and to monitor progression of the disease. Current clinical research tends to focus on knee OA because of the prevalence of the disease in this joint; therefore, this article focuses on radiographic assessment of OA in the tibiofemoral compartment of the knee.

The radiographic definition of OA relies mainly on the evaluation of OPs and JSN. Because OPs are considered specific to OA, develop at an earlier stage than JSN, are more correlated with knee pain, and are easier to ascertain than other radiographic features, they represent the widely applied criterion to define the presence of OA.[1–3] Assessment of OA severity, however, relies mainly on JSN and subchondral bone lesions. Moreover, progression of JSN is the most commonly used criterion for the assessment of OA progression and the complete loss of JSW characterized by bone-on-bone contact is one of the factors considered in the decision for joint replacement.

Radiographs are a 2-D projection of a 3-D joint subject to problems with variability, in particular joint repositioning. Radiographs perform poorly in the detection of early OA and seem insensitive in the determination of disease progression. These limitations have been confirmed by concurrent investigations of joints using more sophisticated imaging method, including arthrography, CT, MRI, and arthroscopy.[4–9] Despite these limitations, conventional radiography commonly is used in clinical practice because radiographs are easily interpreted.

The severity of OA can be estimated using semiquantitative (SQ) scoring systems. Published atlases provide images that represent specific grades.[10,11] Several grading scales incorporating combinations of features also have been developed, including the most widely used, the Kellgren and Lawrence grade classification, which suffers from limitations based on the invalid assumptions that changes in radiographic features (eg, OPs and JSN) are linear over the course of the disease and that the relationship between these features is constant. In contrast, the Osteoarthritis Research Society International atlas classification grades separately the tibiofemoral JSN and OP in each compartment of the knee.

In routine clinical assessment of patients who have suspected OA, standing weight-bearing anteroposterior and lateral radiographs are sufficient imaging in most cases. Additional views may increase diagnostic sensitivity in cases of doubt.[12] Several standardized radiographic protocols have been introduced that are applied in clinical trials and epidemiologic studies. Radiographic protocols of the knee in flexion provide a more reliable image of JSW and bone changes in the tibiofemoral joint. This translates into greater sensitivity for detecting OA progression and more accurate identification of the location of JSN.[13] In particular, radiographs obtained using protocols with the knee in flexion are more sensitive for detecting JSN in the lateral femorotibial compartment. The appropriate identification of the location of JSN in the medial or lateral femorotibial compartment is important to consider for patient selection for longitudinal studies, especially in disease-modifying OA drug clinical trials, to ensure an accurate evaluation of JSN in the follow-up images.

An excellent specificity has been shown for radiography in the detection of longitudinal cartilage loss when compared with MRI as the reference standard. The reported