Introducing *Radiology* Select: Imaging of Joints

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The topic that tends to get most attention in musculoskeletal radiology during continuing medical education courses is imaging of joints, most of which involves magnetic resonance (MR) imaging but also increasingly involves ultrasonography (US). Not only is the anatomy of joints challenging, but joints are also among the sites most frequently studied with MR imaging, and these studies substantially influence patient care.

Bryan et al (1) showed that MR imaging of the knee joint did not increase health care costs and obviated surgery in a significant number of patients. It is critical, however, that radiologists be intimately familiar with the normal and pathologic anatomy of the joints and can provide thorough and competent evaluations to referring physicians.

In this volume of *Radiology* Select, therefore, we focus on "Imaging of Joints," both in recent review articles and in research pertinent to our field. We cover all major joints, in particular the knee, the shoulder, and the hip, but also some of the new developments in cartilage imaging, which is one of the most exciting fields in musculoskeletal imaging research.

Shoulder

The shoulder is the first joint we present. We begin with a review of glenohumeral instability, which encompasses a broad spectrum of clinical complaints and presentations. The review we chose to include in this volume focuses on the imaging findings in three distinct clinical scenarios: acute first-time shoulder dislocation, chronic instability with repeated dislocation, and chronic instability without repeated dislocation (2).

This is followed by a research report on recurrent symptoms after shoulder instability repair and correlating direct MR arthrographic assessment with second-look surgical evaluation (3). A high accuracy for the direct MR arthrographic assessment of labral pathologic conditions and other internal derangements of the shoulder is demonstrated in patients after instability repair.

Another article, in which the same imaging technique, MR arthrography, was used is then presented. The authors investigated its accuracy for detection of lesions of the biceps pulley and describe typical diagnostic signs, including displacement of the long head of the biceps tendon relative to the subscapularis tendon, medial subluxation of the long head of the biceps tendon on transverse images, and presence of biceps tendinopathy (4).

Subsequently, an article on pain after MR arthrography of the shoulder is presented in which the authors demonstrate that neither internal derangements nor prior surgery have an apparent effect on the pain course after MR arthrography of the shoulder (5). Finally a review article on shoulder anatomy and the technique and scanning pitfalls of shoulder US is presented. This is an increasingly important subject, and the authors highlight the accuracy of shoulder US as a function of the examination technique (6).

Video
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Elbow and Wrist

Elbow and wrist imaging are the topic of next group of articles, with three scientific articles on MR imaging of ligaments and plicae of the elbow, hand and wrist early inflammatory arthritis, and the ulnomeniscal homologue of the wrist.

The authors of the first article demonstrate that the elbow ligaments and the posterolateral plica are consistently visible on conventional MR images of asymptomatic subjects. Most normal ligaments are shown to be thinner than 4 mm, and most plicae are thinner than 3 mm (7). In the second article, the important role of tenosynovitis as an imaging finding in early rheumatoid arthritis is outlined, and tenosynovitis of the flexor tendons of the second finger and the extensor carpi ulnaris are shown to be significantly associated with progression to rheumatoid arthritis (8). Finally, we include an in vitro study that correlates anatomic and MR imaging findings of the ulnomeniscal homologue and demonstrates its complex anatomic features because of its obliquely oriented course (9).

Cartilage Imaging

Over the past 10 years, MR imaging of cartilage has evolved as the reference standard for cartilage evaluation and now not only depicts morphologic focal abnormalities of the cartilage but can also provide information on cartilage matrix composition. Availability of 3-T imaging has further advanced this field.

The third section in the volume starts with a review article on advances in imaging of osteoarthritis and cartilage; the authors highlight the development of MR imaging techniques capable of facilitating assessment of cartilage morphology and the methods for evaluating the biochemical composition of cartilage (10). In our next included study, cartilage imaging at 1.5 and 3 T are compared and improved diagnostic performance at 3 T for evaluating the articular cartilage of the knee joint in symptomatic patients is demonstrated (11). In addition to high-field-strength MR, novel three-dimensional (3D) MR sequences are now available for cartilage imaging, with the new 3D fast spin-echo sequences being the most promising in musculoskeletal MR imaging. We include a comprehensive assessment of the diagnostic performance of cartilage imaging with a 3D isotropic-resolution fast spin-echo MR sequence compared with that of conventional MR imaging at 3.0 T (12). This study demonstrates similar diagnostic performance for detecting cartilage lesions, cruciate ligament tears, collateral ligament tears, meniscal tears, and bone marrow edema lesions in the knee joint. Finally we include three scientific studies on quantitative imaging of the cartilage matrix. The first study presents data from the American College of Radiology Imaging Network PA 4001 multicenter trial and shows moderate to excellent reproducibility in a clinical trial network for T1ρ imaging, and T2 mapping (13). The second study presents longitudinal T2-mapping data from the large multi-center Osteoarthritis Initiative study and shows a significant increase in tibiofemoral cartilage T2 measurements over a 2-year period, with a greater increase in T2 being associated with increased progression of cartilage morphologic abnormalities (14). In the third study, the authors analyze the value of adding a T2 mapping sequence to a routine MR imaging protocol at 3 T and find improved sensitivity in the detection of cartilage lesions in the knee joint, from 74.6% to 88.9%, with only a small reduction in specificity (15). Most important, the greatest improvement in sensitivity is found with the use of T2 maps in the identification of early cartilage degeneration.

Knee

Our fourth area of review is the knee. The knee is the most frequently examined joint, because dysfunction of the knee is a major source of disability. MR imaging of anterior cruciate ligament (ACL) injury is one of the major indications for MR imaging. MR imaging provides information about concomitant injuries and allows for monitoring of ACL graft morphology and function.

The first article in this section focuses on osseous injuries associated with ACL tears and investigates the association between osseous injuries and short-term clinical outcome in patients with ACL tear (16). The authors demonstrate that depression fractures in patients with ACL tear are associated with decreased clinical outcome scores 1 year after ACL reconstruction surgery and, therefore, need to be highlighted in the radiology report. ACL reconstruction is another important subject, and the second article presents typical MR imaging features at long-term follow-up and correlates these with functional and clinical evaluation (17). The authors show that small amounts of increased intrasubstance graft signal intensity on intermediate- and T2-weighted images are an expected finding after ACL reconstruction at long-term follow-up and do not correlate with functional limitations.

Recently, imaging around total joint replacements by using novel metal-suppression MR sequences has received considerable attention (18,19) and provides new insights into soft-tissue abnormalities related to metal-on-metal prostheses (20,21). We include a study in which the au-

thors evalauted the sensitivity and specificity of lamellated hyperintense synovitis for infection after knee arthroplasty (22). The study results show that the presence of this type of synovitis has a high sensitivity and specificity for infection.

Next, we turn to the issue of cost-effectiveness research in knee imaging. From a medical-economic perspective, it is important to understand how relevant MR imaging is, in light of the fact that a large number of these patients undergo arthroscopy for nonacute symptoms. We include a study that shows that if this study design is used, MR imaging can be performed without additional costs or disadvantageous effects on function to obviate arthroscopy in patients with nonacute knee symptoms (23).

Finally, we include an article on US of the knee. This was a study on the feasibility of dynamic US for the diagnosis of medial plica syndrome of the knee (24). The results show that dynamic US allows detection of abnormalities of medial plicae in the knee with good sensitivity and specificity.

Hip, Ankle, and Foot

In the final section of this volume we focus on MR imaging of the hip, ankle, and foot. We start with a review on recent developments in hip imaging, including femoroacetabular impingement, structural variants, and pitfalls in hip imaging (25).

In addition to MR imaging this review covers the roles of radiography, CT, and US. Next we include a scientific study that explores the alpha angle for discriminating symptomatic patients with cam-type femoroacetabular impingement from asymptomatic volunteers (26). Since correct evaluation of the anatomy of the hip is critical, the next included study demonstrates the anatomy of the capsular ligaments of the hip with MR arthrography in fresh human cadaver specimens (27). Athletic pubalgia and "sports hernia" are important disease entities in physically active patients, and radiologists need to be familiar with MR imaging findings, which are presented in the subsequent scientific study (28).

Most ligamentous injuries are located lateral at the ankle, and the anatomy of the medial collateral ligaments is less well known; therefore, we include a study that characterizes the MR imaging appearance of the medial collateral ligament complex of the ankle in asymptomatic volunteers (29). The final article in this section is an analysis of fibrosis and adventitious bursae in the plantar fat pad of the forefoot in asymptomatic volunteers and a correlation of MR and histologic findings in cadaveric specimens (30).

In summary, this *Radiology* Select volume provides review articles and scientific studies published in *Radiology* on imaging of joints and includes the highlights from the past 7 years. The articles were chosen to cover important new developments and concepts in imaging of joints, thus providing pertinent information that will be useful to the radiologist in day-to-day practice.

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