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Imaging Modalities for Osteoarthritis

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Radiographs are no longer de rigeur in making the diagnosis of knee osteoarthritis, according to guidelines released by the European League Against Rheumatism last month. Clinical signs, symptoms, and risk factors are sufficient to make the diagnosis.

Yet x-rays and other imaging modalities continue to have a role in osteoarthritis, according to Dr. Ali Guermazi and Dr. David J. Hunter. At present, imaging should primarily be used in research rather than in clinical practice (where its use should be limited to ruling out other likely diagnoses), they agreed.

Imaging conveys information about the pathophysiology of OA and has provided insight into symptoms and progression, said Dr. Hunter, chief of the research division of New England Baptist Hospital in Boston. Ultimately, "it will help to define the best treatments for osteoarthritis," he added. Imaging has the potential to "have wider clinical application, when we have an opportunity to intervene in earlier arthritis through modifying joint structural changes."

Yet, there continues to be "widespread use of different imaging modalities in the clinical setting, where it's clear there is osteoarthritis." Dr. Hunter estimated that 60%–70% of patients who present to him in the clinic have an MRI on CD with them. "It doesn't change the diagnosis or what I'm going to do for them, so I'm not sure that there's much rationale for having that at present."

Each imaging modality has a role to play when assessing the pathophysiology of the whole joint. "Some of that role is complementary, but much of it is unique to that particular modality. … Each has its strengths and weaknesses."

Dr. Guermazi and Dr. Hunter shared their thoughts on how various imaging modalities can further understanding of the pathophysiology of OA.

Radiograph

An x-ray is typically used only to rule out other diagnoses, said Dr. Hunter. These could include rheumatoid arthritis, gout, intra-articular loose bodies, and trauma. "These would be reasons to think about doing additional imaging."

X-ray is still the most widely used imaging modality because it's relatively inexpensive, it's available, and it's relatively easy to interpret. X-rays are useful primarily for outlining the two-dimensional

geometry of the bones. "You infer from the x-ray what the joint space is, and from that, the health and integrity of the cartilage, but it's an indirect inference and you really can't make any direct representations of other tissues," Dr. Hunter said.

In addition, x-ray evaluates features that don't contribute to pain, which is the primary symptom of OA, said Dr. Guermazi, director of the quantitative imaging center and section chief of musculoskeletal imaging at Boston University. "If we look at joint space narrowing, thinking that this is the cartilage measure, [x-ray is] useless for many reasons. Arthritis is defined clinically as pain. Cartilage can't be painful because there are no nerves in it."

Synovitis, effusions, and bone marrow lesions, however, can all be painful. "The only features that are not painful are the ones we are looking at on a radiograph, which are cartilage [inferred from the joint space narrowing] and osteophytes."

Dr. Hunter noted that the imaging community is divided about whether the best way to monitor the structural progression of underlying disease is to measure joint space on x-ray or to measure other features—such as the cartilage itself—on an MRI.

MRI

The main strength of MRI as a research tool is its ability to provide information on many tissues in the joint. "On MRI, you're able to … see changes in the curvature of the bone, lesions within the bone [which demonstrate where focal loading is occurring, and] alterations within the cartilage itself. … You can see inflammation within the joint [such as synovitis or an effusion], the ligaments, and the muscle," said Dr. Hunter.

"The more we're learning about osteoarthritis, the more we're realizing that much of the reason why a person has pain [and] functional limitation—and much of the reason why the joint progresses—has a lot more to do with the tissues in the joint other than cartilage," Dr. Hunter said. "Bone marrow lesions, synovitis, and effusions appear to account for the majority of the reason why a person has pain. MRIs provide a lot of insight there," he said.

Beyond the local-tissue reasons for a person to have symptoms, there is also some local alteration in the neurophysiology. "The communication between different nerve pathways that leads to sensitization of nerves occurs both peripherally and centrally, " Dr. Hunter said.

"If we are focused on symptomatic response, it's helpful to think about the contribution of all of those factors." Nerve endings are present in specific tissues, particularly the bone and synovium.

In MRI, gadolinium contrast can be given intravenously or intra-articularly, said Dr. Guermazi. Intravenous contrast is useful for evaluating synovitis and differentiating it from effusions. Intra-articular contrast is useful for evaluating cartilage and meniscal lesions.

Among the several downsides of MRI are its cost and the time needed to acquire the images and to interpret them. MRIs of the knee or hip are acquired with the patient in a lying down or supine position; however, physiologically, the knee is probably best understood when those joints are bearing weight.

CT

CT is widely available and generally less expensive than MRI. Unlike dual-energy x-ray absorptiometry,

CT imaging can provide information about volumetric density of the bone via changes in the periarticular density, Dr. Hunter said.

The chosen modality may depend on the joint to be imaged, said Dr. Guermazi. In the case of OA of the facet joints, osteophytosis and bone are better viewed with CT than MRI. However, much other information is lost. Although meniscal and anterior/posterior cruciate ligament lesions can be seen on contrast CT, bone marrow lesions cannot.

Ultrasound

"Intra-articular steroids appear to reduce the extent of inflammation in joints. That can be appreciated on ultrasound," said Dr. Hunter. Ultrasound can also be used to guide the injection of corticosteroids. "Some of the therapies that are being developed are likely to be intra-articular, and ultrasound may be helpful in guiding the needle to the right spot."

Ultrasound also is being used in some clinical trials to visualize synovitis, according to Dr. Guermazi. "I think it's promising, especially if you use Doppler and can see vascularity." Doppler ultrasound can be used to identify and monitor active synovitis, after treatment.

Ultrasound is also able to assess the effect of biologic drugs—currently in testing for OA—on synovitis.

Ultrasound is inexpensive, but "it's very operator dependent," said Dr. Guermazi. "Ultrasound tends to be used more widely outside the United States, where MRI may not be so readily available."

Ultrasound allows visualization of ligaments, muscles, and tendons, but not bone, and it can visualize only tissues close to the skin and near the probe.

Therapy

Research into potential OA therapies now focuses on tissues that are likely to play a role symptomatically and structurally, rather than just concentrating on cartilage. Just as bBiologic drugs have made huge inroads in RA, "we're right at the cusp of that" with OA, said Dr. Guermazi. When "therapies do become available, the ability to identify OA in the early stages will be very important."

X-rays can supply information about the structural progression of underlying disease, as evidenced by the osteophytic changes, subchondral bone sclerosis, and absence of joint space seen in an anteroposterior radiograph of the left knee in a 65-year-old woman with secondary arthritis at 9 years after treated fractures (at left). A lateral view (at right) confirms severe tibiofemoral OA and shows severe patellofemoral OA with large posterior femoral condyles (arrowhead) and tibial plateaus (arrow) not seen on the anteroposterior view.

Sagittal fat-suppressed proton density-weighted MRI shows diffuse cartilage loss of the lateral central weight-bearing tibia and femur. Also seen are a central lateral femur bone marrow lesion (arrow) and a small tibiofibular ganglion cyst (arrowhead).

CT can visualize volumetric density. Medial narrowing plus subchondral medial tibiofemoral bone sclerosis (arrows) and cystic changes are seen on coronal reformatted CT.

Source Images courtesy Dr. Ali Guermazi

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