

# SEMPI Priority clinical area: Joint Pain

## INTRODUCTION

### Importance of Joint Pain

In 2010, the Global Burden of Disease Study found that musculoskeletal conditions collectively affect more than 2.9 billion people, with an overall increase in prevalence of 44.7% since 1990 (Arendt-Nielsen, 2017). Women report a higher incidence of joint pain than men, and older individuals are more likely to report joint pain than younger patients. The knee is the most frequently reported area of peripheral joint pain followed by the shoulder, fingers, elbow, hip, ankle, foot, and wrist in decreasing order (Arendt-Nielsen, 2017; Becker et al., 2016; Ellis, 2019).

### History and Presenting Symptoms

The essential elements in evaluating a patient with complaints of joint pain, prior to diagnostic imaging, are a thorough history and complete physical exam. Important in generating a differential diagnosis, such factors as location of pain, the number of joints involved, symmetrical versus asymmetrical distribution, quality and timing of symptom onset, and associated systemic features should be evaluated (Becker et al., 2016; Ellis, 2019). The patient history can also reveal whether the joint pain may be related to injury, inflammation, a mechanical problem, or another illness.

### Classification of Joint Pain

Diagnoses related to **mono-articular** pain commonly suggest trauma, infection, crystalline arthritis, and less commonly avascular necrosis or tumor. Diagnoses related to **poly-articular** pain can include inflammatory arthritis, especially rheumatoid arthritis (RA), later stages of crystalline arthritis, and other autoimmune or vasculitis (Arendt-Nielsen, 2017; Becker et al., 2016). Osteoarthritis and patients with infectious illnesses presenting with joint complaints may fall into either category. Another category, spondyloarthritis (SpA), is comprised of ankylosing spondylitis, psoriatic arthritis, arthritis associated with inflammatory bowel disease, and reactive arthritis. These diseases can present as either mono-articular or poly-articular conditions and may be associated with axial skeletal complaints. Of note, a common cause of musculoskeletal discomfort can involve soft tissues such as tendonitis, bursitis, or strain injury, and for which imaging studies are generally not indicated.

Newer and more sophisticated imaging studies have guided orthopedic care such that improved surgical techniques lead to better results in most forms of joint replacement as well as other reparative procedures (Sullivan et al., 2015). With inflammatory conditions, especially RA and SpA, emphasis on early diagnosis and appropriately aggressive treatment has drastically changed long-term outcomes regarding preservation of

both joint integrity and function (Argyropoulou et al., 2005; Sieper et al., 2005; Hoving et al., 2004; Benton et al., 2004). Various imaging studies are important in assisting with an initial diagnosis as well as providing a potential predictor of disease severity (Ranganath et al., 2015; Griffith et al., 2015; Marks et al., 2015). Attempting to differentiate between an inflammatory versus non-inflammatory cause of joint symptoms remains a key feature in determining the most appropriate imaging studies to pursue.

Primary causes of **inflammatory** joint disease with *potential* radiologic findings:

- Rheumatoid arthritis
- Spondyloarthritis, especially ankylosing spondylitis and psoriatic arthritis
- Systemic lupus erythematosus
- Crystalline arthritis, including early and late-stage gout and chondrocalcinosis
- Inflammatory osteoarthritis
- Septic (bacterial) arthritis
- Necrotizing vasculitis

Primary causes of **non-inflammatory** joint disease with *potential* radiologic findings:

- Osteoarthritis
- Degenerative disc disease
- Fracture
- Soft tissue injury
- Osteomyelitis
- Internal derangement and tears
- Bone tumor
- Paget's disease

It is important to note that a negative or normal imaging study may be as significant as an abnormal study when making decisions about therapeutic options with any disease under evaluation.

## **RADIOLOGICAL EVALUATION OF JOINT PAIN**

Multiple imaging studies, including plain radiographs, computerized tomography, magnetic resonance imaging, and ultrasound are potentially useful when assessing any musculoskeletal problem. Radiation exposure and cost as well as the timing of a procedure are important clinical decisions practitioners need to consider. Studies may be indicated when there is a decrease in or loss of function, inability to bear weight, suspected fracture or infection, history of malignancy, history of trauma, or if the patient is seriously ill. To determine whether an occult or unusual pathologic condition involves a joint, imaging is indicated if joint pain continues despite conservative management or if pain is out of proportion to clinical findings (Becker et al., 2016; DaSilva et al., 2017). An important caveat is to realize that when obtaining an imaging study, one may detect unexpected findings that ultimately need to be explained (Jensen et al., 1994).

### **Radiography**

Plain radiographs (X-rays) are frequently used for initial screening of patients with joint pain prior to considering other procedures as they may be useful in evaluating structural or functional abnormalities (McCauley & Disler, 1998; Argyropoulou et al., 2005). Plain radiographs are quite good for bone details and detecting small calcifications but less helpful for soft tissue changes. On the other hand, soft tissue swelling visible on plain films can be an important clinical finding (Barth, 1997). Erosions visualized on plain films in patients with inflammatory arthritis conditions usually indicate irreversible changes, aggressive disease, and a less favorable prognosis (Sudoł-Szopińska & Greenspan, 2018). Timing of imaging is also key in that a diagnosis of septic arthritis or osteomyelitis may not appear for 10-14 days on plain radiographs (Becker et al., 2016; Ellis, 2019). Lastly, in addition to specific joint films, a chest X-ray may be essential in the evaluation of various systemic diseases with multi-organ involvement especially autoimmune diseases (i.e., Wegener's granulomatosis), sarcoidosis, and paraneoplastic syndromes. Conventional radiographs of peripheral joints utilize low radiation dosages making them useful for follow-up studies. However, plain film imaging of the axial skeleton and pelvis requires higher dosages as well as potential radiation exposure to the gonads and large areas of bone marrow. As such, other imaging modalities for these anatomic areas can be considered that offer lower radiation exposure and the possibility of serial, follow-up studies.

### **Computed Tomography (CT)**

CT scanning offers excellent contrast resolution and is especially useful in locations that are difficult to visualize by conventional X-rays and in some cases of traumatic injury. Although radiation dosages are high with traditional CT imaging, use of 'minimal dose' or 'low dose' CT methods have developed over time thus minimizing this risk. Another use for CT imaging of joints involves those that may be affected by respiratory motion; such that CT minimizes motion artifact during respiration (Sudoł-Szopińska & Greenspan, 2018). While magnetic resonance imaging

(MR) is superior to CT for most musculoskeletal evaluations (see following discussion), CT imaging can be used when MR is contraindicated or unavailable.

## **Magnetic Resonance Imaging (MR)**

MR has distinct advantages in the evaluation of musculoskeletal conditions because of the ability to visualize bone anatomy, bone marrow pathology, and soft tissue structures including synovium, intra-articular structures, and peri-articular structures. Importantly, MR does not involve radiation exposure such that limited MR studies have potential usefulness for serial, follow-up imaging. Although MR offers many advantages in the diagnosis and management of inflammatory, non-inflammatory, infectious, and degenerative disorders, its use may be limited in some locations by availability and higher cost. MR is the procedure of choice for diagnosing avascular necrosis, soft tissue neoplasms, and disc herniation (Griffith et al., 2015; Sudoł-Szopińsk & Greenspan, 2018). An important observation for patients with RA and SpA is that abnormalities associated with these conditions may appear earlier on MR compared to X-ray thus offering the possibility of earlier intervention with disease-modifying agents (Griffith et al., 2015).

## **Ultrasound (US)**

US has a role in the evaluation of bone and soft tissue structures, is free of radiation hazard, and is relatively inexpensive. However, this technique is highly operator dependent and may be difficult for others not involved in the scanning process to interpret (Sudoł-Szopińska & Greenspan, 2018). It is an excellent technique for diagnosing disorders such as rotator cuff tears, superficial tendon integrity, synovial fluid collections, and differentiating deep vein thrombosis from ruptured synovial cysts (Lee et al., 2005). US can be used to guide needle aspiration of fluid collections and inject corticosteroids into areas of inflammation. US is more sensitive than plain films in detecting early erosions of RA (Sewerin et al., 2018; Marks et al., 2015).

## **Arthrography**

Arthrography refers to imaging that involves the injection of contrast material into a joint, and is often performed using CT, or MR guidance. Iodinated contrast is used in CT arthrography and dilute gadolinium in MR arthrography. The injected contrast outlines intra-articular structures differentiate them from adjacent soft tissues, and also distends the joint for better separation and visualization of structures. Arthrography facilitates identification of intra-articular (“loose”) bodies, certain ligament or tendon injuries, synovial or cartilage abnormalities, sinus tracts, and loosening of joint prostheses (Sewerin et al. 2018; Foti et al., 2020. Complications of arthrography are few, with the most common being synovial irritation (chemical synovitis) induced by the contrast agent being used.

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