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Review

The role of imaging modalities in the diagnosis, differential diagnosis and clinical assessment of peripheral joint osteoarthritis

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SUMMARY

Peripheral joint osteoarthritis (OA) is predominantly a clinical diagnosis, though imaging may provide confirmation and aid with differential diagnosis where there is clinical doubt. Whilst radiographs (X-rays (XR)) are usually the first-line imaging modality selected, magnetic resonance imaging (MRI), ultrasound and computed tomography (CT) may all have a valuable role in assessing a person with OA, although each has its particular advantages and disadvantages. MRI is of particular use for diagnosing bone conditions that may cause a rapid increase in symptoms, such as avascular necrosis (AVN) or a subchondral insufficiency fracture (SIF), while providing concomitant soft tissue assessment. Ultrasound offers rapid assessment of peripheral joints and can easily assess for features of inflammatory arthritis. CT is faster to perform than MRI and can also image the subchondral bone, but does involve ionising radiation. Selecting the correct imaging modality, in the context of its advantages when visualising a specific joint (e.g., hand vs knee) and with clinical context in mind, will enhance the added value of imaging in clinical practice.

Introduction

Whilst the diagnosis of osteoarthritis (OA) is usually made clinically, imaging may be used to confirm the diagnosis or examine alternative diagnoses when there is clinical doubt. This review aims to discuss the application of widely available imaging modalities including radiographs, ultrasound, magnetic resonance imaging (MRI) and computed tomography (CT) in clinical practice, both in the diagnosis and monitoring of OA and when assessing other conditions which may occur concomitantly or as a differential diagnosis of OA. Such conditions included in this review include rapidly progressive OA, avascular necrosis (AVN) of the femoral head, subchondral insufficiency fractures (SIF), calcium pyrophosphate deposition (CPPD) and gout. The role of imaging to help differentiate between OA and inflammatory arthritis is also discussed.

Utility of imaging in the diagnosis of peripheral joint OA

A number of commonly used imaging modalities may have a diagnostic role in clinical practice: plain radiographs (X-rays (XR)), ultrasound and MRI. CT may also be considered in settings where MRI is not available. Imaging is not usually required for the diagnosis of OA and should be used where there is doubt over the clinical diagnosis or to exclude a differential diagnosis. While XRs remain the cheapest, easiest and first-line choice for imaging examination in suspected OA, the American College of Rheumatology (ACR)[1], the UK National Institute for Health and Clinical Excellence (NICE)[2] and the European League Against Rheumatism (EULAR)[3] support the clinical diagnosis of knee OA based on clinical symptoms and examination findings, without requiring an XR. Recent EULAR recommendations also acknowledged that the diagnosis of knee OA can be made in the presence of specific clinical and examination features, even if a radiograph appears normal[3]. It is important to realise that the added value that an imaging modality brings to diagnosis depends on the pre-test probability of a specific diagnosis.

Radiographs in the diagnosis of OA

Studies comparing radiological with clinical criteria for the diagnosis of OA knee have shown a wide range of sensitivities and

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specifities for XR imaging[4,5]. XRs are insensitive to the earliest pathological changes seen in OA[6] and therefore may appear normal[7]. Furthermore, even among expert readers, the degree of reported osteophytosis and joint space narrowing (JSN) may be variable[8]. A systematic review noted agreement between radiological and clinical diagnosis in only 4/39 studies assessed, there was no agreement in 7/39 studies and inconsistent agreement in the remainder[9]. Furthermore, due to the projectional nature of XR, the radiographic diagnosis of OA depends on the XR view used, with the likelihood of a diagnosis of knee OA increasing with the number of XR views used[10]. Using a posteroanterior (PA) view alone (the standard view requested by most non-specialist clinicians, for example primary care doctors) identifies only 56% of cases of radiographic OA, adding a skyline or lateral view increased the identification to 87%, and all three views increases identification to almost 100%. Hence requesting a PA knee XR is not necessary to confirm the diagnosis of OA in a person fulfilling clinical criteria for OA but should be used in the correct clinical context to confirm other diagnoses, for example, if there is a history of trauma (to diagnose potential fracture), if the person's symptoms suggest inflammatory arthritis, or if an alternate diagnosis is probable.

With regards to hand OA, the ACR criteria for classification of hand OA note that physical examination has been shown to be more sensitive and specific than XRs for diagnosing symptomatic hand OA[11]. However, XRs remain the current validated principal imaging technique to examine the morphological changes of hand OA[12]. Classic individual radiographic features such as JSN and osteophytes are sensitive for the diagnosis of OA and the presence of more than one radiographic feature of OA (JSN, osteophytes, subchondral bone cysts and sclerosis), particularly if combined with typical clinical features, strongly increases diagnostic certainty[12]. EULAR recommends that further diagnostic imaging is seldom needed to confirm a diagnosis of hand OA[12]. In clinical practice, if a patient presents with an abrupt onset of interphalangeal joint pain and functional loss with inflammatory symptoms, performing a hand XR to assess for erosive OA, which can present in such a way and may have a worse outcome than non-erosive hand OA, may be of help in confirming the diagnosis[12].

There are no international guidelines for the diagnosis of hip OA, but the ACR classification criteria has demonstrated that the radiographic presence of osteophytes is both sensitive and specific to hip OA[11]. In clinical practice, although examination features such as reduction of internal rotation and hip pain (usually felt in the groin or deep buttock) may allow the clinician to diagnose hip OA with confidence[11], an XR is often helpful to confirm the diagnosis and in particular to exclude other diagnoses.

Ultrasound in the diagnosis of OA

Ultrasound avoids radiation and is comfortable and convenient for the patient but requires a skilled operator. US can assess most peripheral OA joint pathologies depending on its acoustic window: it can visualise synovial hypertrophy and inflammation (using both grey scale and power Doppler techniques), osteophytes, cartilage (near the joint surface) and the superficial components of the menisci (including detecting extrusion) in the knee. Ultrasound detects more osteophytes in OA hand joints than XR, especially at the metacarpophalangeal joints[13]. Ultrasound cannot assess subchondral bone lesions such as cysts, and the findings may vary depending on joint positioning[14]. Ultrasound imaging requires a skilled operator as the findings may be operator-dependent, for example, the thickness of measured cartilage may depend on the angle with which the transducer is held.

A systematic review assessing the relationship between ultrasound findings and a clinical diagnosis of OA included 47 studies including OA of the knee, hand, hip and foot and noted that there was no consistent relationship between clinical diagnosis and ultrasound-detected pathology[15]. This review did note that several of the included papers did not have a clear definition of clinical OA and where it was included, the definition of OA was not consistent across studies. Ongoing development of accepted ultrasound definition of OA will improve consistency across studies, aiding both clinical diagnosis of OA and offering potential for monitoring both disease progression and response to treatment[16]. Ultrasound can be very helpful in the clinic in the differential diagnosis of painful joints, for example, detection of widespread Power Doppler positive synovitis with erosions would add weight to a diagnosis of inflammatory arthritis in the hands, or the presence of meniscal extrusion and cyst with JSN in a swollen knee may favour a diagnosis of OA.

MRI in the diagnosis of OA

MRI offers superb soft tissue contrast in a tomographic presentation and has the advantage over XR or ultrasound of visualising all the structures within a joint, including the subchondral bone (Fig. 1). As mentioned, MRI can detect structural change when the XR is normal[7]. MRI detection of synovitis (Fig. 2) is improved with intravenous contrast by enabling differentiation from joint effusion[17], however such contrast agents require intravenous access, have very small risks of sensitivity reactions and are associated with rare side effects such as nephrogenic fibrosis[18]. In practice, it is common to get useful and diagnostic information on the extent of soft tissue and bone pathologies using non-contrast MRI; when specific synovitis sequences are needed it is worth involving a radiologist.

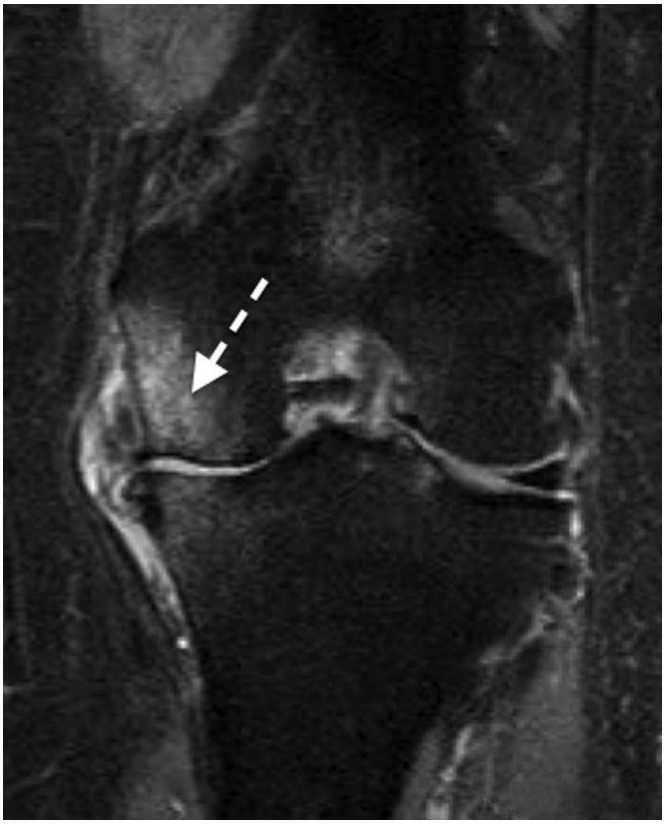

Fig. 1. Fat suppressed, proton density MRI of the knee (coronal view) demonstrating bone marrow lesions (arrowed). Note also the macerated medial meniscus and medial osteophytes.