

Hands On

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Musculoskeletal imaging for GPs

Jonathan D Spratt

Consultant Radiologist, Co Durham & Darlington NHS
Foundation Trust/Spire Washington Hospital

Editorial

'Do I need an x-ray or scan?' is a question often posed by patients with musculoskeletal problems. The answer depends on many factors and it is important to weigh up the pros and cons before putting pen to request card. This report encourages clinicians to think what question they hope to answer and how this might affect the management of the patient. It is helpful to think of an imaging request as part of a clinical decision-making flowchart rather than a separate entity.

The report takes us through different imaging modalities and how they should – and should not – be used in the management of MSK conditions in primary care. Open access for GPs to imaging such as MRI has been debated for many years. This is very relevant for GPs involved in commissioning services. It describes the evidence for open-access MRI for spine and knee problems and so is timely.

Finally we are reminded to treat the patient and not the x-ray – an old adage that has stood the test of time.

Simon Somerville

Introduction

GPs are increasingly being offered direct access to multimodality imaging for musculoskeletal (MSK) complaints for those patients most likely to benefit, fuelled by the Department of Health's 18-week target implemented in 2008. In some Trusts GPs have direct access to magnetic resonance imaging (MRI) and MSK ultrasound, resulting in a more satisfying experience for patient and doctor alike.

X-ray

Full patient information and clinical details must be specified on the x-ray request to enable legal justification for exposure to ionising radiation.¹ The list of doses from various x-ray exposures (Box 1) reveals that the lumbar spine series has 90 times and a joint x-ray 3 times the radiation dose of a posteroanterior (PA) chest x-ray. The average background annual absorbed dose in the UK is around 2.5 mSv (equivalent to 125 PA chest x-rays). An abdominal computerised tomography (CT) scan (500 frontal chest x-ray equivalents) in a teenager is thought to raise the life-time risk of inducing haematological malignancy to 1 in 1000.

BOX 1. Diagnostic examination effective doses (mSv).

Single x-ray

- Skull (PA and lateral) (0.04)
- Limb or joint (0.06)
- Chest (PA) (0.02), chest (lateral) (0.04)
- Abdomen (0.7)

Contrast examination, x-ray series or CT

- Cervical (0.27), thoracic (1.4), lumbar (1.8) series
- Intravenous urogram (2.5)
- Barium enema (7.0)
- CT abdomen (10)

General indications for MSK x-ray examination are given in Box 2. X-rays should be performed in all cases of significant trauma or acute peripheral joint or bony pain with a lower threshold in unexplained symptoms in the young and old where there are incident peaks with malignancy.

BOX 2. Indications for x-ray examination.

- Bony tenderness
- Inability to weight-bear
- Acute joint pain
- Gross joint deformity
- Acute spinal pain in elderly (to rule out osteoporotic wedge fracture)

Spine

Cervical spine x-rays should be performed in trauma, to assess bony alignment – e.g. in rheumatoid patients (flexion and extension lateral views) – and to delineate osteoarthritis (OA). In non-traumatic acute neck pain x-ray examination is not usually helpful as most resolves on conservative management, but after 6–8 weeks with no improvement, or if lifestyle is affected or focal neurology demonstrated, or in those with a history of malignancy, specialist referral is indicated.

X-rays are *not* indicated for the vast majority of back pain cases. Acute spinal pain and presumed osteoporotic collapse in elderly patients do warrant plain x-ray examination. If pain is persistent, difficult to manage or associated with long tract signs or red flags, specialist referral is indicated. X-rays cannot detect disc prolapses, and are unreliable in diagnosis of lateral recess, central canal or exit foraminal stenosis.

Spinal x-rays are not indicated in the vast majority of back pain cases.

Shoulder

X-ray examination is indicated with shoulder pain where impingement syndrome or rotator cuff pathology is suspected, and may highlight OA, calcific tendinitis (Figure 1) and reduced subacromial space. A history of shoulder trauma and instability also warrant x-ray.

Marked reduction of subacromial space on a shoulder x-ray usually indicates a significant rotator cuff tear.

Elbow

In elbow pain with suspected OA or loose bodies, or post trauma, x-ray examination is indicated. The majority of cases of epicondylitis are managed with no imaging initially but suspected joint effusion necessitates x-ray analysis (with ultrasound). X-rays do not contribute to the management of the vast majority of soft tissue lumps throughout the body but are indicated with bony lumps (Figure 2).

Knee

Chronic knee pain warrants x-ray examination at any age. In the >50 age group x-ray examination must be performed before requesting an MRI as the former can highlight OA, which is often the major contributor to symptoms despite concurrent meniscal or ligamentous abnormality (Figure 3). Anterior knee pain with suspected injury to the extensor mechanism (quadriceps and patellar tendons) or lump necessitates ultrasound examination first.



FIGURE 1. Florid calcific tendinitis in supraspinatus (x-ray).

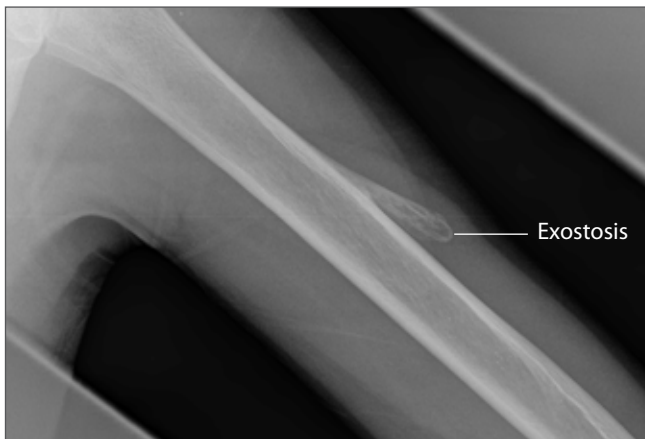


FIGURE 2. Exostosis (osteochondroma) mid humerus (x-ray).

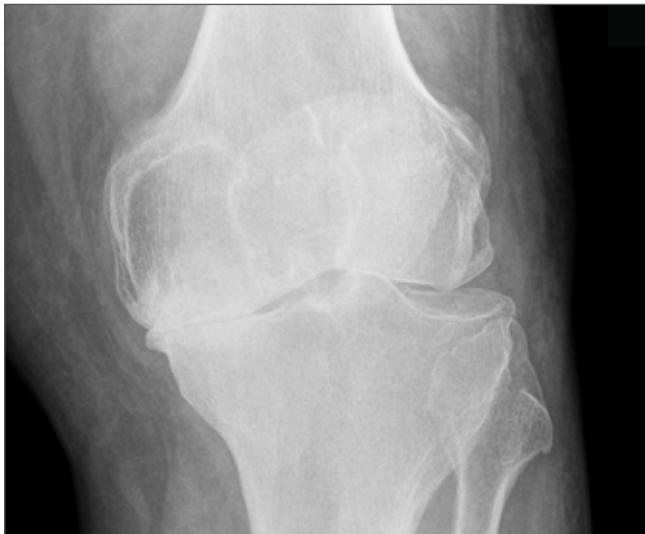


FIGURE 3. Established OA of knee (weight-bearing) (x-ray).

In patients >50 years with non-acute knee pain, x-ray examination is much more useful to orthopaedic surgeons than MRI as OA usually dominates clinical symptoms.

Ankle, foot

Ankle and foot pain following trauma, suspected OA or other bony pathology necessitates x-ray examination.

Ultrasound

Ultrasound has emerged as a useful imaging technique for evaluating soft tissue and joint-related abnormalities with open access from primary care available in many centres and should be the first choice of investigation for a range of MSK complaints (Box 3).

BOX 3. Ultrasound applications.

- Articular pain, swelling or mechanical symptoms without definitive diagnosis
- Shoulder pain or mechanical symptoms
- Symptoms near a joint
- Regional neuropathic pain to diagnose neural entrapment
- Guiding articular/periarticular aspiration or injection
- Diagnosis and treatment assessment of synovitis

Ultrasound has many advantages compared with MRI (Box 4). Requests for ultrasound should ask specific questions with sufficient clinical detail.

BOX 4. Ultrasound advantages.

- Cheaper, more accessible and better tolerated than MRI
- Preferred modality for tendinopathy and muscle trauma
- As accurate as MRI in diagnosis of rotator cuff tears
- Dynamic examination and intervention possible

TENDINOPATHY/MUSCLE TRAUMA

Ultrasound is the preferred modality for tendinopathy and muscle trauma. GP referrals must be compatible with Royal College of Radiologists (RCR) guidelines, agreed 18-week pathways and any locally agreed guidelines, which are likely to vary between departments. There are however limited guidelines for referral for MSK ultrasound in the available literature. A community-based shoulder-screening ultrasound clinic run by a GPwSI and a physiotherapist can potentially keep half of referred patients out of hospital.

If an x-ray is also indicated this should be performed prior to ultrasound referral.

Shoulder

In experienced hands ultrasound may be very accurate in the diagnosis of rotator cuff tears (Figure 4) with sensitivity of over 90% for full thickness tear within 3 weeks of injury. Early cuff repair has a better prognosis.

- Shoulder ultrasound should not be performed to diagnose adhesive capsulitis.
- Consider early referral for ultrasound in suspected rotator cuff tears.

Dynamic examination may show impingement often associated with subacromial bursitis. Some units offer ultrasound-guided injection of confirmed bursitis in a one-stop setting and ultrasound-guided needle barbotage of florid and severely symptomatic calcific tendinitis (Figure 5). Synovitis, paralabral cysts and subcutaneous or intramuscular lipomas may also be diagnosed, as can acromioclavicular joint arthritis or subluxation.

There are 'blind spots' for shoulder ultrasound (Box 5).

BOX 5. Shoulder ultrasound 'blind spots'.

- Labral and proximal biceps tendon tears
- Frozen shoulder (clinical diagnosis)
- Bone marrow infiltrative disorders/metastases
- Glenohumeral OA
- Avascular necrosis

Elbow, wrist, hand

At the elbow, olecranon bursitis, golfer's and tennis elbow and ulnar nerve cubital tunnel impingement can be demonstrated. In the hand and wrist ganglion cyst and carpal tunnel or Guyon's canal syndromes (ulnar nerve) may be

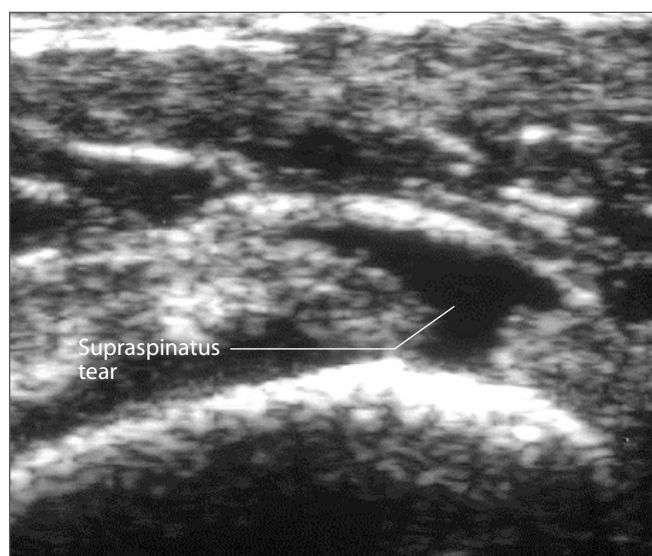


FIGURE 4. Supraspinatus full thickness tear (ultrasound).

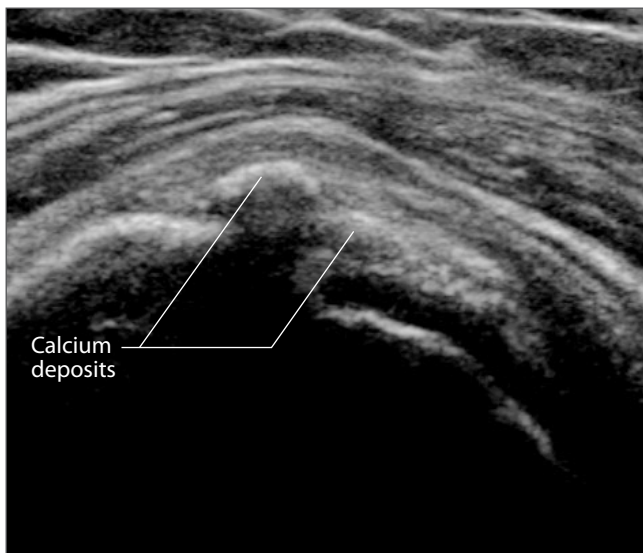


FIGURE 5. Supraspinatus calcific tendinitis (ultrasound).

diagnosed. The ulnar or median nerves can be impinged by lipoma, aberrant muscles or infiltrations from granulomatous disease, e.g. sarcoidosis.

De Quervain's tenosynovitis, a common cause of subacute wrist pain, may be diagnosed and treated with ultrasound-guided steroid injection into the associated tendon sheath/s.

Knee

At the knee many causes of anterior knee pain may be diagnosed with ultrasound (Box 6). Joint line pain from meniscal cysts or popliteal fossa pain caused by Baker's (popliteal) cyst or popliteal artery aneurysm may be diagnosed. Ultrasound cannot assess the posterior or anterior cruciate ligaments and is not comprehensive enough to assess the collateral ligaments, menisci or osteochondral surfaces.

BOX 6. Anterior knee pain ultrasound diagnosis.

- Patella or quadriceps tendinitis or tears
- Pre- or deep infrapatellar bursitis
- Hoffitis (infrapatellar fat pad)
- Synovial plica with effusion
- Iliotibial band syndrome (runner's knee)
- Synovitis

Ankle, foot

In the foot and around the ankle, ultrasound can detect a ganglion cyst, Morton's neuroma, plantar fasciitis, Achilles and tibialis posterior tendin-

opathy (Box 7) and the hypervascular synovitis and early erosions of rheumatoid disease or subarticular marginal erosions and tophi of gout.

BOX 7. Associations with common ankle and foot tendon pathology.

Tibialis posterior tenosynovitis

- Obese, women >40 years, joggers
- Inflammatory arthritis
- Flat foot

Achilles insertional enthesopathy

- Psoriasis, inflammatory arthritis, Reiter's syndrome
- Diabetes mellitus
- Trauma

HERNIAS/SUPERFICIAL LUMPS

Ultrasound is also the first choice for investigating groin or abdominal wall hernias and for superficial lumps. Patients with these clinical complaints will be seen in a specialist MSK ultrasound clinic where the consultant or sonographer has special expertise in these particular examinations.

Ultrasound can aid in the diagnosis by offering information on size, shape, location and appearance of superficial lumps with 'probe palpation', perfusion imaging and dynamic examination offering considerable advantage over MRI (Box 8). All superficial lumps that have any atypical features from the commonest pathologies, e.g. sebaceous cyst and lipoma, or which exhibit unusual size, require ultrasound analysis (especially before minor surgery in the primary care setting) as palpably soft lesions could well exhibit vascularity associated with more complex pathology, including malignant disease.

BOX 8. Ultrasound diagnoses for hip, groin and abdominal wall pain and/or lump.

- Gluteal, hamstring and psoas enthesopathy
- Psoas and ischial bursitis
- Inguinal and femoral hernia
- Gilmore's groin (tear of conjoint tendon at external inguinal ring)
- Spigelian and paraumbilical hernia
- Lipoma, lymphadenopathy

All superficial lumps with atypical features or unusual size require ultrasound analysis before minor surgery in the primary care setting to avoid unsuspected malignancy and hypervascularity.

Magnetic resonance imaging

Direct access to MRI offers major benefits for the improved diagnosis and management of certain acute and chronic clinical conditions:

- **Spine:** malignancy, infection (Figure 6), fracture, acute disc prolapse with motor weakness (Figure 7) or cauda equina syndrome, inflammatory disorders such as ankylosing spondylitis
- **Knee:** meniscal, ligament (Figures 8, 9) or muscle tears, osteochondral injury and occult fractures
- **Upper limb:** neural entrapment syndromes, enabling targeted surgery (Figure 10).

In many centres, GPs can refer directly for spine and knee conditions. A 2008 paper retrospectively reviewing 1798 open-access GP MRI scans at St Mary's Hospital, London over 12 years revealed a wide range of scans requested per GP (from 1 to 240!) with an average of 8.5 per GP.² GP MRI encompassed 2.6% of the total MRI workload. Spine, knee and brain imaging covered the majority of GP requests (86%). The normal report rate (48%) was found to be comparable with previous studies of outpatient referrals. Of note was the lack of any available referral guidelines for GPs and no formal dissemination of the RCR guidelines for MRI use. The use of guidelines has been shown to improve GPs' knowledge and understanding of MRI.^{3,4}

Since 2006 there has been an explosion in GP referrals in many centres, and they now comprise typically almost 40% of total MRI referrals.

A list of absolute contraindications (Box 9) can be used as an initial screening tool for the GP. It is possible to scan 6 weeks after hardware implantation. Relative contraindications include first trimester of pregnancy, claustrophobia and patients over 140 kg (discuss with unit before referral), intravascular stents, filters and coils, shrapnel injuries, penile implants, ocular implants, heart valve replacement, cerebral aneurysm clip and any other unknown implant until it has been determined as MRI safe.

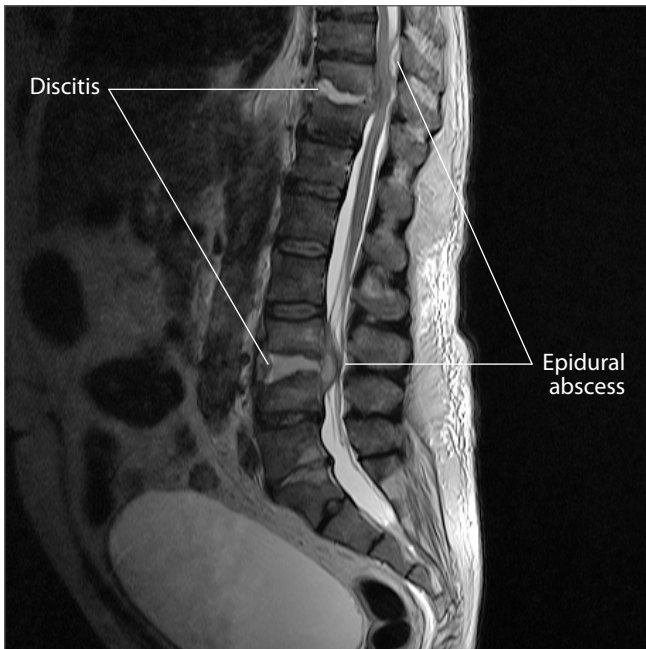


FIGURE 6. Multilevel discitis and epidural abscess with cauda equina compression with urinary retention (sagittal MRI).



FIGURE 9. Lateral collateral ligament tear (coronal MRI).

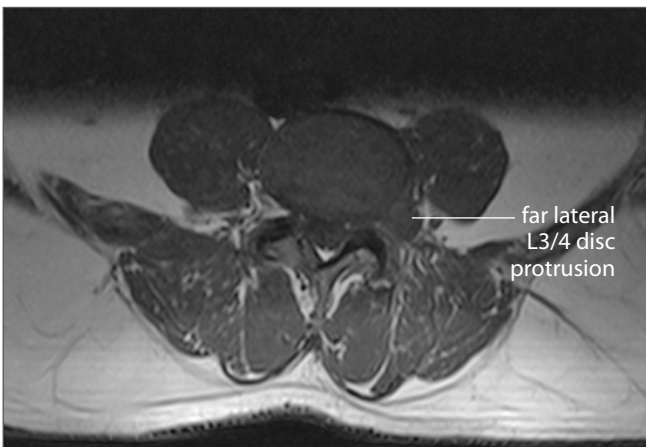


FIGURE 7. Far lateral L3/4 disc protrusion causing persistent left knee/thigh pain (axial MRI).

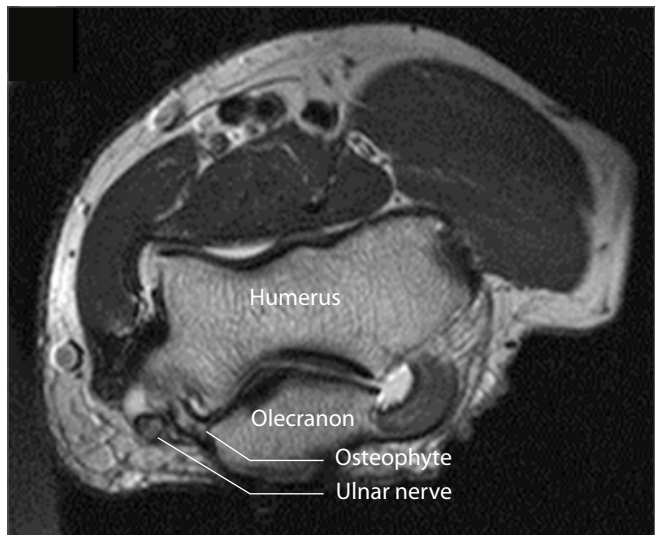


FIGURE 10. Ulnar neuritis in cubital tunnel at elbow from impinging osteophyte (axial MRI).



FIGURE 8. Posterior cruciate ligament tear (sagittal MRI).

BOX 9. Absolute contraindications to MRI.

- Pacemaker or cardiac defibrillator
- Cochlear implant
- Neurostimulator
- Orbital or spinal metallic foreign body
- Untested intracranial aneurysm clips
- Infusion pumps
- Implanted drug infusion ports

Spine

Routine referral for MRI spine is indicated after 6–12 weeks of genuine radiculopathy with no improvement on conservative therapy in the context where referral for surgery is considered appropriate and the patient is willing to consider

surgery. Expedited referral is for patients with acute and severe radiculopathy or low back pain who lie within high risk groups (Box 10) or exhibit red flags (Box 11).

BOX 10. Referral for MRI spine requiring lower threshold in high-risk groups.

- <20 or >55 years
- Osteoporosis
- Alcoholism
- HIV
- Drug abuse
- Steroid therapy
- Adolescent athletic injury
- Malignancy (suspected or diagnosed)

BOX 11. Clinical red flags for expedited spinal MRI.

- Sphincter or gait disturbance
- Saddle anaesthesia
- Motor loss
- Elevated plasma viscosity
- Weight loss, fever and other systemic symptoms
- Asians with history of recent travel to subcontinent
- TB contact
- Structural deformity
- Non-mechanical back pain (no relief with bed rest)
- Thoracic pain

Expedited referral for MRI should not delay referral for specialist opinion, which can be performed at the same time.

Spinal TB can present with relatively innocuous initial symptoms – often only low back pain – and may progress to paralysis. Suspected spinal TB necessitates expedited MRI referral in those higher-risk patients who may have low-grade fever, lymphocytosis, raised plasma viscosity and anaemia. The presence of gait or sphincter disturbance and saddle anaesthesia may be subtle and raise the possibility of cauda equina syndrome, which warrants same-day specialist referral as per local policy (Figure 6).

Patients with persistent low back pain in the absence of radiculopathy, red flags or altered biomarkers do not usually require any imaging,

whether MRI or x-ray. Where osteoporotic vertebral wedge fracture is suspected and ruled out with x-ray, MRI is indicated only within the context of a referral for spinal fusion for persistent or recurrent pain between 6 weeks' and 12 months' duration.⁵

Many chronic spinal pain patients improve with aggressive active rehabilitation programmes and for those that don't, imaging tests still may not be necessary. The decision to refer for imaging should include an evaluation of the patient's quality of life, psychological distress, suitability and self-inclusion for surgery.⁵

Knee

Concerning knee MRI, the cost-effectiveness of GP referral has been questioned. A pragmatic multicentre randomised trial (two parallel groups of 553 patients consulting their GP about a continuing knee problem recruited from 163 general practices at 11 UK sites) highlighted whether the small, clinical benefits from GP access to knee MRI is worth the cost of imaging.⁶ While yielding only small benefits in patients' knee-related quality of life but non-significant improvements in physical functioning, negative MRI findings could allow GPs to reassure patients, treat them conservatively in primary care, avoid unnecessary orthopaedic referrals, reduce waiting times, and save costs. Positive MRI findings could confirm GPs' clinical diagnoses and decisions to refer to orthopaedic specialists, who could decide whether arthroscopy was needed without the need for a second appointment. The radiologist's report could also help to prioritise outpatient appointments.

This said, patients' health might benefit more from referral by their GP to MSK interface services, allowing more selective use of MRI. Imaging may also confuse the clinical picture if it detects asymptomatic abnormalities, possibly leading to unnecessary referrals and interventions. As not all GPs understand MRI findings that are reported by radiologists, the time-honoured and reliable tradition of 'treating the patient, not the scan' could be jeopardised in some cases, which could result in false reassurance and delays in appropriate treatment.

Radionuclide imaging

Radionuclide bone scanning detects areas of altered bone metabolism, revealing occult

fractures, bone infections, arthritis or malignancy. The National Institute for Health and Clinical Excellence (NICE) referral guidelines for suspected cancer (2005)⁷ state expedited referral for increasing, unexplained or persistent bone pain or tenderness, particularly pain at rest (especially if not within the joint) or an unexplained lump. Bone scanning should follow x-ray examination, especially if this is non-contributory and symptoms persist and where bone function tests are abnormal. Myeloma however can give a negative bone scan as it doesn't incite the bone repair (osteoclastic) activity that uptakes the radiopharmaceutical. If suspected, urinalysis for Bence Jones protein and plasma electrophoresis is required. Full screening skeletal survey is usually reserved for request by a consultant haematologist.

Pitfall of bone scan: Myeloma cannot be excluded.

Conclusion

GPs find that community-led imaging and consultant-supported reporting can prevent unnecessary referrals to secondary care, or indeed may help direct the patient toward the most appropriate specialist and also prioritise outpatient appointments. However, care is required in the interpretation of imaging reports as experience and specialist knowledge may be required with regard to the meaning of a negative test which does not necessarily obviate significant pathology. The best patient outcome is when a close working relationship is facilitated between GPs and radiologists within the frame-

work of guidelines developed by multidisciplinary teams. Almost 40% of MRI scans in the UK are now generated by GPs, which is a testament to the perceived usefulness of direct access to imaging.

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Further reading

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Continuing professional development (CPD) task

Case presentation 1

A teenage boy presents with a hard lump in the anterior thigh increasing over 3 weeks with chronic pain.

- Any specific questions?
- What is preferred initial diagnostic modality?
- What is the differential diagnosis?

Case presentation 2

Another teenage boy presents with a 6-month history of pain in his right hip, initially intermittent but now continuous, tending to be worse at night. There was no exacerbation with exercise. Partial relief was gained by non-steroidal anti-inflammatory medication. Examination revealed vague mild upper femoral tenderness only.

- What is the most likely diagnosis?
- What radiological and other tests would be most appropriate to confirm?

Case presentation 3

A 34-year-old woman presents with a 2-week history of shoulder pain after a fall on her outstretched arm. An x-ray was performed on the day of injury which was normal.

- What is the most likely diagnosis?
- What is the next most appropriate diagnostic test?

Answers

1. Further questioning reveals a history of contact sport (rugby) and some minor incidental bruising on the thigh 5 weeks previously. Ultrasound and x-ray are the preferred initial modalities which diagnose myositis ossificans, a calcifying and ossifying haematoma. 40% of such cases have no specific history of trauma and can lead to chronic pain; surgery may be indicated.
2. Osteoid osteoma (benign cortical tumour of osteoblastic nidus surrounded by reactive sclerosis). Imaging features are characteristic and diagnostic. X-ray would show a small lytic lesion (nidus) surrounded by cortical thickening and sclerosis in the femoral neck, and radioisotope bone scanning with $^{99m}\text{TcMDP}$ reveals a very focal and characteristically hot nidus in the centre of this cortical abnormality. Many tertiary referral MSK units now offer minimally invasive radio frequency ablation to treat these.
A normal white cell count and CRP/ESR would make the differential diagnoses of osteomyelitis, septic arthritis and bone abscess unlikely and lack of onset of pain or exacerbation related to exercise makes stress fracture unlikely.
3. Rotator cuff tear. Expedited ultrasound and then referral as early repair has a better prognosis. Ultrasound can also diagnose radiographically occult undisplaced fractures of the greater tuberosity!

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Derbyshire S41 7TD

Tel 0300 790 0400 **Fax** 01246 558007
Email enquiries@arthritisresearchuk.org
www.arthritisresearchuk.org

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Medical Editor: Simon Somerville.
Project Editor: Keir Windsor
(k.windsor@arthritisresearchuk.org).

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