Imaging of ulnar-sided wrist pain

ABSTRACT

Ulnar-sided wrist pain is a complex entity to diagnose clinically and frequently requires imaging to help confirm or determine the diagnosis. This article reviews the imaging and the logical imaging pathway of the common causes of ulnar-sided wrist pain, and illustrates various pathologies. It also discusses appropriate imaging modalities for various conditions. The causes of ulnar-sided wrist pain are stratified according to the affected anatomical structures, such as bony, soft tissue or neurovascular aetiologies. This review provides a handy imaging framework for non-radiologist clinicians of the common conditions producing ulnar-sided wrist pain. A linked article (https://doi.org/10.12968/hmed.2019.80.8.456) detailing the diagnosis of ulnar-sided wrist pain is included in this issue.

Ulnar-sided wrist pain often presents a diagnostic dilemma because it has many causes, and clinical examination techniques have poor specificity. Imaging can help to guide diagnosis but can be affected by the occurrence of positive imaging findings that are clinically asymptomatic. This article reviews the imaging appearances of common causes of ulnar-sided wrist pain for the non-specialist. The causes are divided into sections according to the anatomical origin of the pain: bone, soft tissue or neurovascular.

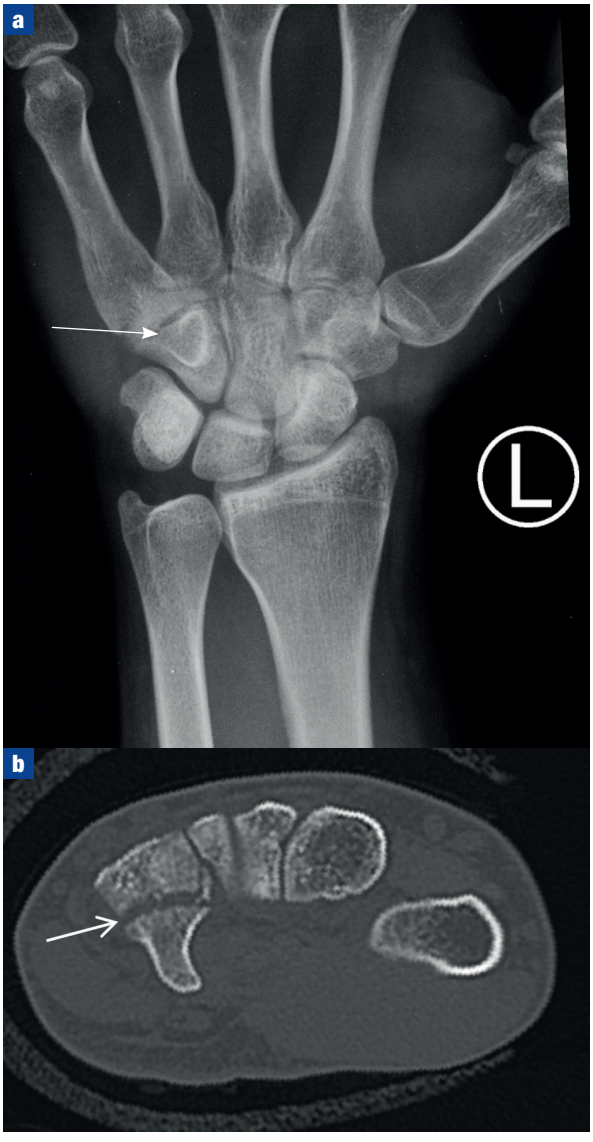

Figure 1. **a.** Anteroposterior radiograph of the wrist showing a very subtle hook of hamate fracture (arrow). This fracture is challenging to diagnose on conventional plain radiographs. **b.** Axial computed tomography scan easily demonstrates the hook of hamate fracture (arrow).

If bony pathology is suspected then plain film combined with magnetic resonance imaging for more subtle areas of bone marrow oedema is suggested. Tendinopathy can be readily imaged with ultrasound, which has the advantage of being able to dynamically examine the tendons, which can detect tendinous subluxations. Deep ligamentous injuries such as triangular fibrocartilage complex tears require magnetic resonance imaging or magnetic resonance arthrogram for diagnosis, with plain magnetic resonance imaging sufficient in the majority of cases. Neurovascular causes, such as compression of the ulnar nerve in Guyon's canal syndrome, requires a combination of the above modalities to investigate the causative factor.

Bone

Fractures

Hook of hamate fractures can be difficult to see on traditional anteroposterior and lateral plain X-ray views (*Figure 1a*). If a hook of hamate fracture is suspected clinically then three additional views can be used: the carpal tunnel view, the supinated oblique view with the

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wrist dorsiflexed, and the lateral view projected through the first web space with the thumb abducted. A chronic hook of hamate fracture that has gone unrecognized can present with ulnar nerve palsy, ulnar artery compromise, and attritional rupture of the fourth and fifth flexor tendons. Computed tomography (*Figure 1b*) or magnetic resonance imaging is suggested if a high clinical concern remains and plain X-rays are equivocal (Andresen et al, 1999).

Avascular necrosis

Avascular necrosis of the lunate bone or Kienböck's disease is a progressive destructive process that can ultimately lead to mechanical failure; this progression can be defined using the Lichtman classification stages I–IV. The later stages (II–IV) demonstrate increasing degrees of sclerosis and loss of volume on plain X-ray (*Figures 2a* and *b*) and computed tomography which is often readily apparent. Stage I disease in contrast is characterized only by clinical symptoms and bone marrow oedema on magnetic resonance imaging with normal architecture and density on plain X-ray and computed tomography. Of cases of Kienböck's disease 78% are associated with a negative ulnar variance, whereby the ulnar articular surface is proximal to the radial articular surface (specifically the lunate notch) by more than 2.5 mm (Arnaiz et al, 2014). This must be measured on a well-positioned wrist X-ray with neutral wrist position, 90° of shoulder abduction and 90° of elbow flexion, as ulnar variance is dependent on positioning. While noting that negative ulnar variance is useful, the vast majority of patients with a negative ulnar variance will never develop Kienböck's disease, and this needs to be considered carefully with the clinical scenario.

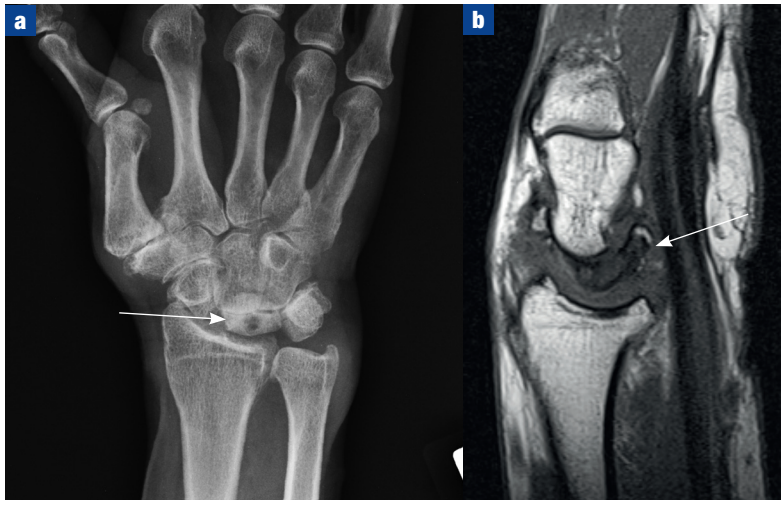

Figure 2. **a.** Anteroposterior radiograph of the wrist demonstrating Kienböck's disease. The lunate is sclerotic and small in size (arrow). There is a negative ulnar variance and incidental osteoarthritis at the base of the thumb metacarpal. **b.** Sagittal magnetic resonance image T1 sequence of the wrist in advanced Kienböck's disease (same patient). The lunate is low signal indicating sclerosis, and is fragmented with loss of the normal moon-shaped morphology (arrow).

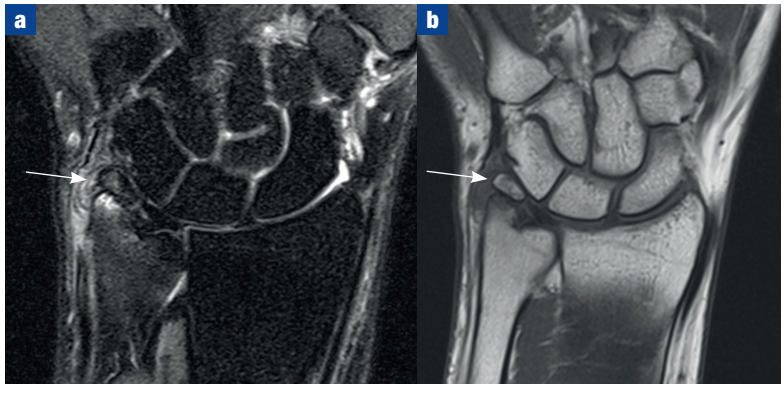

Figure 3. **a.** Magnetic resonance image coronal short tau inversion recovery (STIR) sequence of the wrist, demonstrating ulnocarpal impaction syndrome, with bone marrow oedema in the distal ulna and subtle oedema in the adjoining triquetrum (arrow). There is also surrounding soft tissue thickening and oedema. **b.** Coronal T1 sequences demonstrating ulnocarpal impaction syndrome, with a separate bony fragment at the styloid tip (arrow). This represents an old fracture with non-union.

Ulnar impaction

Positive ulnar variance

Ulnar-sided impaction is greatly influenced by ulnar variance; usually this is positive ulnar variance but can occasionally be neutral or negative. The most common predisposing causes of positive ulnar variance are congenital, secondary to malunion of the distal radius, premature physeal closure of the distal radius or previous radial head resection. These causative pathologies are usually apparent on plain radiographs and should be searched for.

The pain in ulnar impaction arises from secondary degenerative changes, usually a continuum of degenerative tear of the triangular fibrocartilage complex, chondromalacia of the lunate, triquetrum or ulnar head, tear of the lunotriquetral ligament and finally osteoarthritis of the ulnocarpal and distal radioulnar joint. Chondromalacia in the lunate secondary to ulnar impaction syndrome can mimic Kienböck's disease, but Kienböck's disease lesions are more diffuse or affect the radial half of the lunate bone compared with involvement of only the ulnar aspect in ulnar impaction syndrome (Cerezal et al, 2002).

Ulnocarpal impaction syndrome

This is a variation of the ulnar impaction syndromes and occurs in the setting of an old non-united ulnar styloid fracture that impacts on the triquetrum, producing ulnar-sided impingement symptoms (*Figures 3a* and *b*). This is differentiated from ulnar impaction because the impaction point is centred on the triquetrum, rather than the lunate.

Degenerative

Pisotriquetral osteoarthritis

Pisotriquetral joint osteoarthritis often remains undiagnosed because of difficulty in appreciating it on plain X-rays (*Figure 4*). If it is suspected an oblique, 30° supinated radiograph can be performed to bring the pisotriquetral joint into profile where the four typical osteoarthritis radiological manifestations may be evident:

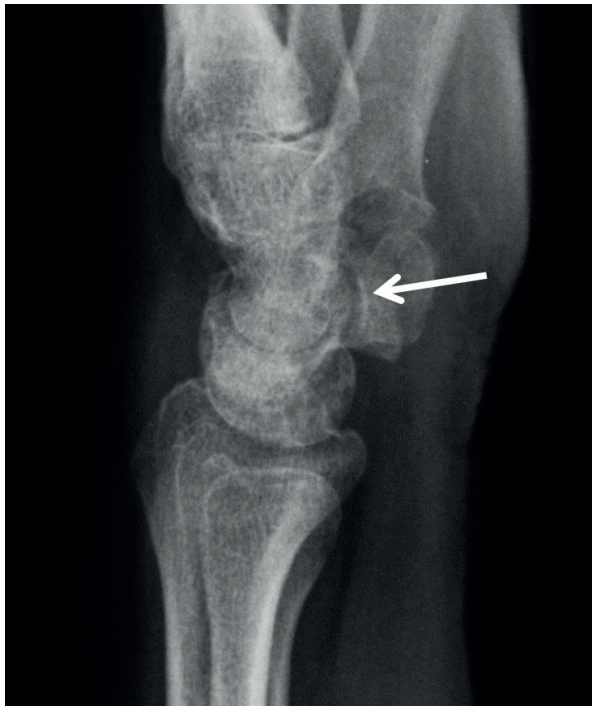

Figure 4. Lateral radiograph of the wrist showing pisotriquetral osteoarthritis (arrow).

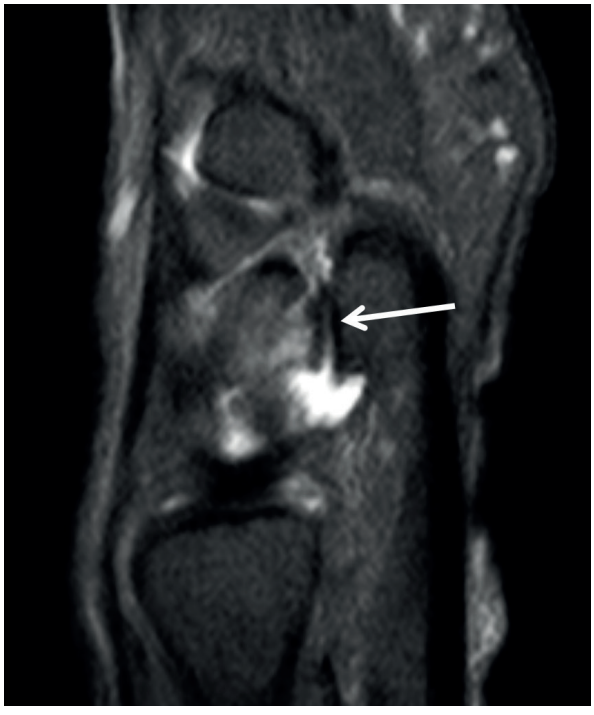

Figure 5. Magnetic resonance sagittal short tau inversion recovery (STIR) sequence image of the wrist, demonstrating the pisotriquetral joint. There is subchondral oedema suggestive of osteoarthritis (arrow) and tiny osteophytes are seen proximally.

1. Loss of joint space
2. Osteophytes
3. Subchondral cysts
4. Subchondral sclerosis.

In advanced cases there may be secondary osteochondromatosis, with loose bodies in the inferior and superior pisotriquetral recesses. Computed tomography or magnetic resonance imaging of the wrist will adequately cover the joint, and magnetic resonance imaging (*Figure 5*) has the added advantage of imaging the chondral surfaces for early signs of chondromalacia (Blum et al, 2006).

Distal radioulnar arthritis

Distal radioulnar joint arthritis can be a result of inflammatory joint disease, primary or secondary osteoarthritis. Secondary osteoarthritis can be a result of trauma or less often a congenital abnormality such as Madelung deformity, which would be readily apparent on plain radiographs. Secondary distal radioulnar joint osteoarthritis becomes evident on plain radiographs over time, but if the causative factor can be identified early this can be treated to limit progression. Distal radioulnar joint instability is often cited as the main risk factor for developing secondary osteoarthritis; this results from fractures involving the distal radius or ulnar, as well as soft tissue injuries such as triangular fibrocartilage complex tears (Watanabe et al, 2010). The best study for visualizing a subluxation or dislocation at the distal radioulnar joint is a computed tomography examination of both wrists performed in both pronation and supination (Szabo, 2006).

Soft tissue

Tendons

Extensor carpi ulnaris tendinopathy is characterized by inflammation of the sixth extensor compartment. Plain radiography is invariably normal in these cases, indeed diagnosis is usually clinical. If there is diagnostic uncertainty ultrasound or magnetic resonance imaging may be used. Ultrasound is fast and relatively inexpensive, with the added advantage of being able to actively target the specific area of pain and perform dynamic movements, such as subluxation of the extensor carpi ulnaris tendon during supination. Magnetic resonance imaging (*Figure 6a* and *b*) has the advantage of being able to examine the

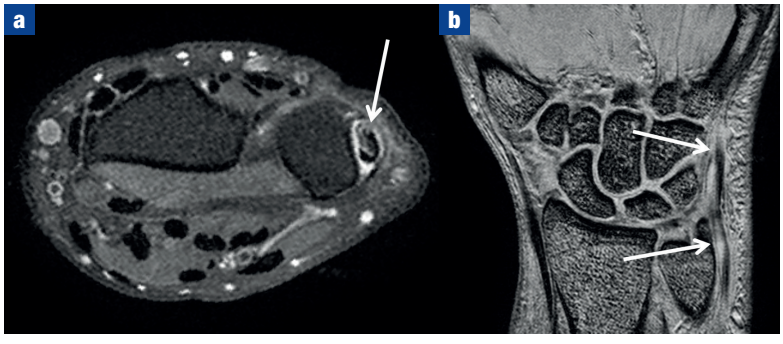

Figure 6. Magnetic resonance image short tau inversion recovery (STIR) sequences of the wrist **(a)** axial and **(b)** coronal demonstrate high signal fluid in the extensor carpi ulnaris tendon sheath (arrows) consistent with tenosynovitis. There is also high signal within a thickened extensor carpi ulnaris tendon as a result of an interstitial tear.

bones and deeper cartilage or ligaments of the wrist joint, which may be required if there is clinical concern of deeper pathology, such as a triangular fibrocartilage complex tear (Plotkin et al, 2016).

Ligaments

The triangular fibrocartilage complex stabilizes the distal radioulnar joint and chronic injury can result in distal radioulnar joint laxity with secondary degenerative osteoarthritis. Diagnosis currently relies on magnetic resonance imaging. Magnetic resonance arthrogram is slightly more sensitive and specific than plain magnetic resonance imaging, but in most cases it is not necessary to perform magnetic resonance arthrogram to delineate the triangular fibrocartilage complex and the vast majority of surgically relevant pathology will be visible on plain magnetic resonance imaging (*Figure 7*). Minor perforations of the triangular fibrocartilage complex may be missed but these are of questionable surgical relevance (Ng et al, 2017).

Neurovascular

Ulnar nerve

Guyon's canal syndrome is injury of the distal ulnar nerve as it travels through a narrow anatomical corridor between the pistiform and hook of hamate. Common causes include ganglion cyst, hook of hamate fracture, tumours (e.g. lipoma) and repetitive trauma (e.g. seen in cyclists caused by the handlebar). Hypothenar hammer syndrome is related to the latter of these causes whereby chronic compression of the ulnar artery between the hook of hamate and the palmaris brevis results in ulnar artery thrombosis. Swelling of the artery can compress the ulnar nerve, resulting in pain and ulnar nerve palsy. The imaging appearances clearly depend on the cause: plain X-rays can be used to identify traumatic causes, such as hook of hamate fracture (explained earlier), whereas Doppler ultrasound can be used to identify ulnar artery thrombosis. Magnetic resonance imaging (*Figures 8a* and *b*) is the best modality to evaluate anatomical variants in Guyon's canal and structures causing mechanical compression (ganglion cysts and lipomas) (Choi et al, 2015).

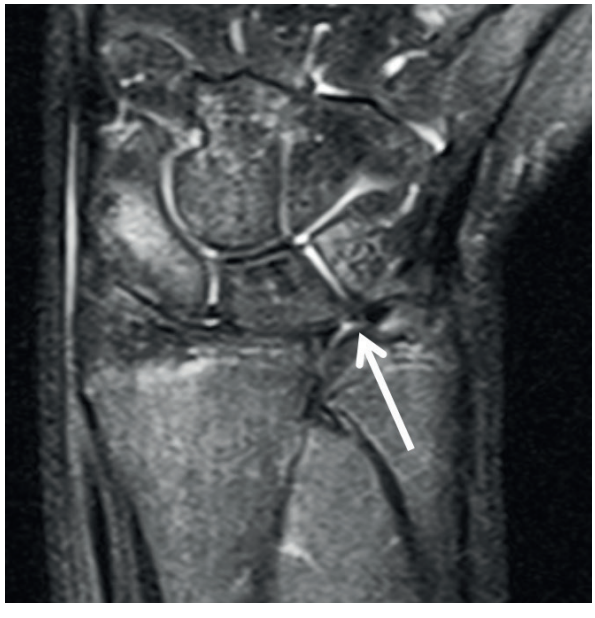

Figure 7. Coronal short tau inversion recovery (STIR) sequence of the wrist demonstrating a central triangular fibrocartilage tear (arrow), in this young patient with ulnar-sided pain following a fall.

Conclusions

Use of imaging in ulnar-sided wrist pain should be targeted and appropriate. Many of the causes can be diagnosed following clinical assessment and plain radiographs but increasingly further imaging is requested to confirm the diagnosis. If there is diagnostic uncertainty then the imaging modality of choice will vary depending on local expertise, time and cost efficiency, patient comfort and clinical need.

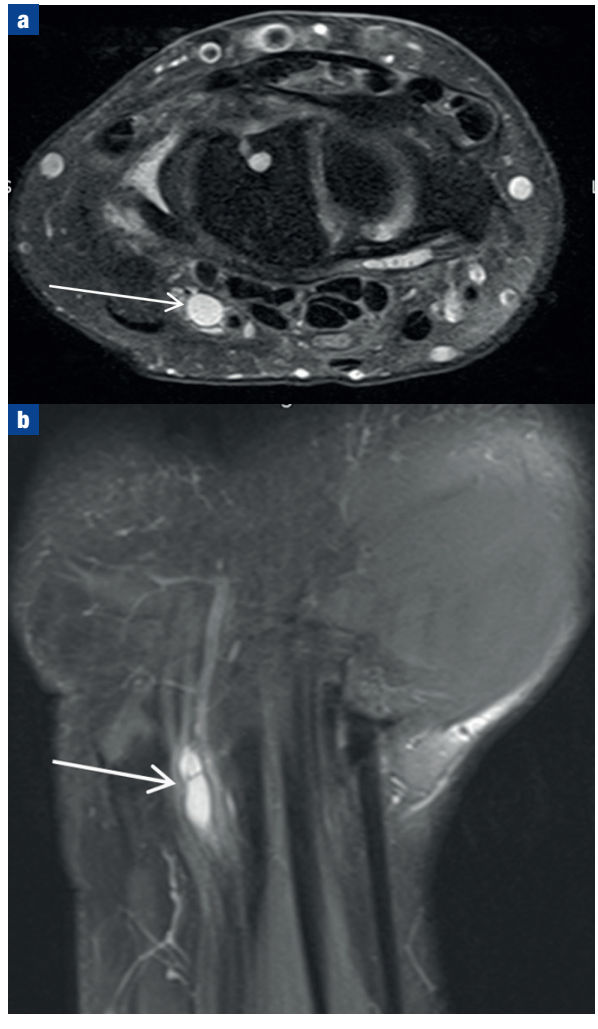

Figure 8. Magnetic resonance imaging short tau inversion recovery (STIR) sequence of the wrist. **a.** Axial image demonstrating a high signal ganglion cyst in Guyon's canal impinging the ulnar nerve (arrow). **b.** Coronal image demonstrates a bi-lobed ganglion cyst in Guyon's canal impinging the linear ulnar nerve (arrow) on the ulnar aspect of the wrist.

As a general rule, ultrasound is recommended for assessment of superficial structures like tendons and arteries. Magnetic resonance imaging is recommended for assessment of deeper structures such as bone or ligaments or indeed, global evaluation of the wrist. Magnetic resonance arthrograms are useful for assessing the internal ligaments. **BJHM**

Conflict of interest: none.

KEY POINTS

- Imaging should be directed by a thorough history and examination, in combination with plain X-ray findings.
- If occult fractures or other bony pathology like avascular necrosis is suspected then magnetic resonance imaging is the most sensitive modality.
- Computed tomography is useful in delineating the bony anatomy and assessment of subtle fractures, such as the hook of hamate.
- Magnetic resonance imaging is also the modality of choice for imaging the intrinsic ligaments of the wrist, such as the triangular fibrocartilage complex. Magnetic resonance arthrograms are not usually necessary and their use should be limited to specialists.
- Tendinous injuries or suspected ulnar artery thrombosis should be initially investigated with ultrasound.

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