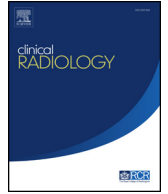




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Pictorial Review

MDCT of hand and wrist infections: emphasis on compartmental anatomy

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Hand and wrist infections can present with a spectrum of manifestations ranging from cellulitis to deep-space collections. The various infectious processes can be categorised as superficial or deep infections based on their respective locations relative to the tendons. Superficial hand infections are located superficial to the tendons and are comprised of cellulitis, lymphangitis, paronychia, pulp-space infections, herpetic whitlow, and include volar as well as dorsal subcutaneous abscesses. Deep hand infections are located deep to the tendon sheaths and include synovial space infections, such as infectious tenosynovitis, deep fascial space infections, septic arthritis, necrotising fasciitis, and osteomyelitis. Knowledge of hand and wrist compartmental anatomy is essential for the accurate diagnosis and management of hand infections. Although early and superficial infections of the hand may respond to non-surgical management, most hand infections are surgical emergencies. Multidetector computed tomography (MDCT), with its multiplanar reformation (MPR) and three-dimensional (3D) capabilities, is a powerful tool in the emergency setting for the evaluation of acute hand and wrist pathology. The clinical and imaging features of hand and wrist infections as evident on MDCT will be reviewed with emphasis on contiguous and closed synovial and deep fascial spaces. Knowledge of hand compartmental anatomy enables accurate characterisation of the infectious process and localise the extent of disease in the acute setting.

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Introduction

A wide spectrum of infectious processes occurs in the hand and wrist, which are broadly classified as superficial and deep infections based on their respective locations

relative to the tendons. Superficial hand infections include cellulitis, lymphangitis, paronychia, pulp-space infections, herpetic whitlow, as well as volar and dorsal subcutaneous abscesses, all located superficial to the tendons. Conversely, deep hand infections include synovial space infections, such as infectious tenosynovitis, deep fascial space infections, septic arthritis, necrotising fasciitis, and osteomyelitis, all located deep to the tendon sheaths. Early and superficial infections of the hand may respond to non-surgical management; however, most hand infections are surgical emergencies. Hence, an accurate and timely diagnosis is

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critical, and it is therefore, important for the radiologist to understand the potential spaces of the hand and wrist to aid the surgeon in identifying the compartment where the infection has occurred. Hand infections often suffer from delayed presentation and thus delay in diagnosis. Early diagnosis and appropriate management is essential to prevent prolonged recovery or adverse outcome such as amputation.¹

Although hand and wrist infections can have diverse clinical manifestations, the most common locations for infection have been described by Türker *et al.*² as the palm and dorsal hand (21%), the middle finger or third web space (17%), and the index finger and second web space (16%). As expected, the most common aetiology for infection is penetrating injury, spanning from lacerations to bites from humans or other animals.^{2–4} As such, the three most commonly isolated microorganisms in the latter series were methicillin-resistant *Staphylococcus aureus* (MRSA), beta-haemolytic *Streptococcus*, and methicillin-susceptible *Staphylococcus aureus* (MSSA).² Imahara & Friedrich³ confirmed the rising incidence of community acquired-MRSA (CA-MRSA) in surgically treated hand infections and also noted intravenous drug use as the only independent risk factor for CA-MRSA. A large review on 1,507 hand infections requiring incision and drainage showed inoculation with MRSA in 53% of the cases.³ Tenosynovitis was the most common type of infection in this study, comprising 67.3% of the patients followed by soft-tissue abscess and septic arthritis comprising the remaining 28.9%.³

Hand and wrist infections are common and there is emerging literature on the imaging evaluation of these conditions.^{5,6} In uncomplicated cases of some superficial hand infections, such as paronychia or felons, imaging may not be required at all. Most of the other forms of hand infection require initial evaluation with radiographs to detect foreign bodies, subcutaneous emphysema, or fractures.⁵ Radiographs, however, provide limited assessment of the regional soft tissues. Conversely, although magnetic resonance imaging (MRI) enables improved characterisation of hand and wrist infections, particularly their soft-tissue extent, it is not a readily available modality overnight and can be time consuming. Ultrasound also lends itself to evaluation for soft-tissue infections of the hand and wrist, especially detection of superficial fluid collections, but it requires expertise that may not be available at all hours. In addition, ultrasound cannot assess the underlying skeletal structures. Multidetector computed tomography (MDCT), with its multiplanar reformation (MPR) and three-dimensional (3D) capabilities, is a useful tool in the emergency setting for evaluation of complicated superficial and deep hand and wrist infections due to rapid MDCT image acquisition and wide availability. Knowledge of hand compartmental anatomy on MDCT can enable accurate characterisation of hand and wrist infection and localise the extent of disease for treatment. In this article, the clinical and imaging features of hand and wrist infections as evident on MDCT will be reviewed, with description of the various closed and contiguous compartmental spaces.

Spectrum of superficial hand infections

Superficial hand infections are those superficial to the tendons and include cellulitis, lymphangitis, paronychia, pulp-space infections, herpetic whitlow, and volar as well as dorsal subcutaneous abscesses.

Cellulitis

Cellulitis refers to superficial inflammation of the skin and subcutaneous tissues without a fluid collection or abscess formation. The occurrence of cellulitis is probably far more common than noted, as cellulitis is one of the few non-surgically managed hand infections and retrospective reviews of hand infections typically focus on surgical disease^{2,3}; however, Brown & Young⁷ assessed hand and wrist infections that were admitted to the hospital and reported cellulitis as the most common type of process. Analogous to infections elsewhere in the hand, penetrating injury can contribute to the development of cellulitis, but is not necessary for its inception. Although the diagnosis is classically established clinically, imaging may be required to assess for the presence or absence of deeper extent and fluid collections.⁸ Imaging features of cellulitis include skin thickening and induration of the subcutaneous tissues without a loculated fluid collection or deeper extension of inflammatory changes (Fig 1). Once the extent of infection is established, treatment consists of antibiotics, including



Figure 1 A 43-year-old man with a history of intravenous drug use presented with superficial hand infection. 3D CT image show moderate soft-tissue swelling and stranding superficially (arrow) extending over the dorsal and radial aspect of the proximal phalanx of the long finger consistent with cellulitis.

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