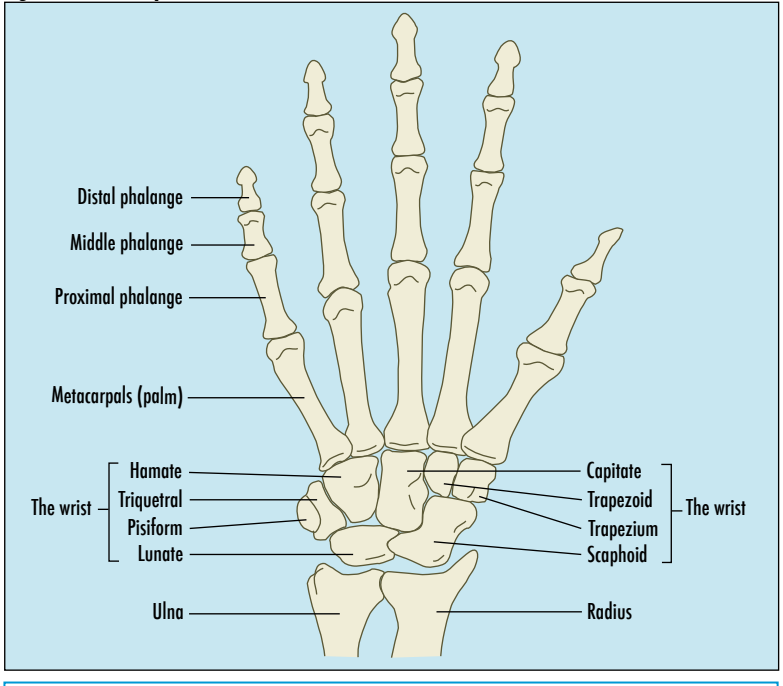
Management of surgical conditions of the wrist

The wrist is a joint with multiple ranges of motion, which permit a wide range of functional applications. This article reviews the surgical conditions that adversely affect wrist function and the management of these conditions.

The wrist joint is made up of fifteen bones which articulate with one another depending on proximity. Flexor and extensor tendons run on the volar and dorsal aspects respectively and enable three-dimensional movements. Other important neurovascular structures are found at the wrist and any condition that affects these can lead to pain and stiffness with a subsequent reduction in functional ability.

As mentioned above, the wrist joint is made up of several different bony articulations (*Figure 1*). When commencing proximally, description of the first articulation involves the distal radioulnar joint – this is a pivot joint involving the articulation of the distal radius and ulna, linked via a syndesmosis, and is responsible for pronation and supination. The next articulation involves the distal radius and ulna and the proximal row of carpal bones. The proximal row from ulna to radial are the pisiform, triquetral, lunate and scaphoid. The latter two articulate with the radius as this is slightly longer than the ulna.

Figure 1. Anatomy of the wrist.



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The midcarpal joint is the S-shaped joint space separating the proximal and distal rows of carpal bones. From ulna to radial the distal row are the hamate, capitate, trapezoid and trapezium. The eight carpal bones are interconnected via a complex ligamentous structure that allows movement in many directions. Disruption of the bony or soft tissue of the wrist can lead to significant pathology.

In order to adequately assess carpal ligament integrity and then proceed successfully to repair, reattachment or reconstruction, recognition and appreciation of wrist anatomy is paramount. Knowledge of normal ligamentous attachment is essential in the primary assessment and subsequent successful treatment of carpal ligament injury and/or carpal instability (Taleisnik, 1976; Berger, 1997; Nagao et al, 2005).

There are six extensor compartments at the wrist dorsum. The first is commonly involved in tenosynovitis (De Quervain's disease). The carpal tunnel is a finite space on the palmar aspect of the wrist that contains the median nerve, flexor digitorum superficialis and profundus tendons and flexor pollicus longus tendon.

Three main nerves and two main arteries cross the wrist joint. These are the ulnar, radial (sensory only) and median nerves as well as the ulnar and radial arteries. Conditions of the vascular supply can be occlusive or traumatic and are often managed in conjunction with a vascular or plastic surgeon. As such these will not be discussed in this article. Compression of the median and ulnar nerves is commonly described by patients and this require decompression at the carpel tunnel and Guyon's canal respectively.

A common symptom associated with surgical conditions of the wrist is pain. This can either be localized or diffuse. There are typical diagnostic signs and symptoms leading to the underlying aetiology. As with all conditions, adequate history and examination will provide the correct diagnosis. Diffuse pain is commonly caused by arthritides. Less common conditions such as chronic regional pain syndrome and wrist laxity are also described.

Arthritides

The aetiology of wrist arthritis is diverse. *Table 1* lists the most common causes.

Patterns of recognition exist when assessing signs and symptoms of surgical wrist disease. The diagnosis is aided by demonstrating clinical pathology at three anatomical areas (*Table 2*). Eliciting signs and symptoms in these three regions that have been present more chronically are indicative of some the conditions listed in *Table 2*.

Rheumatoid arthritis

Rheumatoid arthritis is a chronic, T-cell mediated, autoimmune disorder that adversely affects synovial tissue throughout the body. Hypertrophy of diseased soft tissue results in altered local structures. Intra-articular joint destruction is coupled with extra-articular manifestations as local supporting structures are stretched. These alterations lead to the disruption of the anatomy of both bone and soft tissue. The advent of disease-modifying anti-rheumatic drugs has lead to a reduction in the number of rheumatoid arthritis patients requiring surgical intervention (Chung and Pushman, 2011). However, recommendations for surgical reconstruction still exist, based upon the demonstration of reduced function and increased pain (Alderman et al, 2003). Emphasis has been placed by some on the potential for aesthetic improvement (Bogoch and Judd, 2002; Manske, 2002). As the disease progresses patients possess varying degrees of pain and loss of function which can be summarized as:

- Synovitis without deformity
- Synovitis with passively correctable deformity
- The joint architecture is maintained but deformity is fixed
- Articular destruction.

Surgery is divided into preventative, reconstructive and salvage. The decision about what procedure to perform is made in conjunction with the medical, surgical and rehabilitative teams in a multidisciplinary approach. Preoperative patient education must be performed judiciously as expectation must be appropriately managed. Return to pre-morbid function is often difficult with lengthy recovery and postoperative splintage. Surgery ranges from soft tissue procedures such as flexor or extensor synovectomy, capsulodesis and tendon tranfers for functional restoration, to salvage procedures such as limited or total arthrodesis. Arthoplasty exists within this surgical spectrum but success with this method of fixation is guarded (Ward et al, 2011). No reported literature supports cessation of medication such as anti-tumour necrosis factor before surgery. However, inter-institution variation results in confounding bias. It is essential to consult local guidelines where necessary (*Figures 2* and *3*).

Osteoarthritis

A genetic predisposition to osteoarthritis has long been postulated with evidence further establishing a genetic link to the disease process (Loughlin, 2011). However, there is also an appreciation that osteoarthritis of the wrist is secondary to traumatic ligamentous or bony injury (Feydy et al, 2009). Osteoarthritis is a condition commonly encountered in orthopaedic practice (Weiss, 2009). It is broadly divided into primary or secondary osteoarthritis. Primary osteoarthritis is an idiopathic phe-

Table 1. Most common conditions leading to arthritis of the wrist

Cause	Type(s)
Idiopathic	Base of thumb arthritis
	Generalized osteoarthritis
	Scapho-trapezial-trapezoid osteoarthritis
	Piso-triquetral osteoarthritis
Mechanical	Scaphoid non-union and advanced collapse
	Scapho-lunate advanced collapse
Metabolic	Gout
	Pseudo-gout
Inflammatory	Rheumatoid
	Psoriatic
	Systemic lupus erythematosus
	Scleroderma

Table 2. The diagnosis of surgical conditions of the wrist according to three anatomical areas

Anatomical area of the wrist	Condition(s)
Radial	De Quervain's disease
	Ganglion
	Scaphoid fracture
	Scaphoid fracture non-union with the possibility of scaphoid non-union and advanced collapse
	Scapho-trapezial-trapezoid osteoarthritis
	Carpometacarpal osteoarthritis
Dorsal	Ganglion
	Avascular necrosis of the lunate (Keinbock's disease)
	Scapho-lunate dissociation (motion imbalance as a result of ligament injury)
	Scapho-lunate advanced collapse (arthritis secondary to ligament injury and instability)
Ulna	Distorted distal radioulnar joint after radius fracture
	Distal radioulnar joint osteoarthritis
	Distal radioulnar joint instability
	Triangular fibrocartilage complex injury or degeneration
	Hamate hook fracture and non-union
	Piso-triquetral osteoarthritis
	Extensor carpi ulnaris tendonitis

nomenon, occurring in previously intact joints and having no apparent initiating factor. The secondary type is more common and usually occurs after significant fractures around the wrist in the post-traumatic setting. It is particularly intra-articular fractures of the radius, scaphoid fractures, bony non-unions or ligament disruption of the wrist which can lead to patterns of instability (Watson and Ryu, 1986). There is subsequent abnormal loading with these pathological processes which results in altered wrist kinematics (Talwalkar et al, 2008). The mainstay of surgical intervention is to provide pain relief, while maintaining strength and mobility (Le Nen et al, 2011).

Scapho-lunate advanced collapse of the wrist

The scapho-lunate advanced collapse of the wrist has been comprehensively described by Watson and Ballet (1984). Damage to the scapho-lunate ligament leads to rotary subluxation of the scaphoid. The scaphoid flexes secondary to injury and osteoarthritis develops over its proximal pole and the dorsal rim of the radius. It then spreads to the entire radio-scaphoid joint (Strauch, 2011) (*Figure 4*).

Figure 2. Juvenile rheumatoid arthritis.

Figure 3. Rheumatoid arthritis with and without surgery.

Scaphoid non-union advanced collapse of the wrist

Scaphoid fractures are at risk of developing a non-union as a result of their unique vascular supply. Fractures can lead to vascular compromise and a subsequent non-union. Arthritis progresses in a similar manner as above.

Thumb carpometacarpal osteoarthritis

This condition is found in up to 70% of those over the age of 60 years and mostly affects the postmenopausal female population (female preponderance of 10:1) (Yao and Park, 2008). Clinical examination reveals a prominence at the base of the thumb with pain on axial loading and thumb extension or flexion. Conservative measures involve splint immobilization and analgesia in order to achieve satisfactory pain relief. Intra-articular steroid injections also improve functional outcomes (Talwalkar et al, 2008), and appear to provide temporary relief. If non-operative treatment fails, many surgical techniques have been described (Earp, 2008). Surgical intervention involves removal of the trapezium with various procedures to stabilize the base of the thumb. These include ligament reconstruction, metacarpal extension osteotomy, arthroscopic partial trapeziectomy, implant arthroplasty, and trapeziectomy with or without ligament reconstruction and tendon interposition (Van Heest and Kallemeier, 2008). When embarking on surgical treatment options, managing patient expectation is critical. Procedures involve joint immobilization for approximately 6 weeks after surgery with restoration of preoperative function taking up to 6 months (*Figure 5*).

Distal radioulnar joint and triangular fibrocartilage complex pathology

Articulation of the radius and ulna takes place at the sigmoid notch of the distal radioulnar joint. The base of the

Figure 4. Scapho-lunate advanced collapse of the wrist.

ulna is attached to the radius via a cartilaginous disc-like structure termed the triangular fibrocartilage complex. Both dorsal and palmar radioulnar ligaments make up the triangular fibrocartilage complex and act as the principal stabilizer of the articulation (Gutiérrez et al, 2007). The radius is permitted to rotate around the ulna resulting in wrist pronation and supination. Damage to these structures results in pain and abnormalities of movement. Disruption of the distal radioulnar joint can result from trauma, degenerative and inflammatory conditions.

Dynamic distal radioulnar joint instability commonly results from traumatic disruption of the distal radioulnar ligaments of the triangular fibrocartilage complex after a fall onto the outstretched, hyperpronated hand (Teoh and Yam, 2005).

When considering distal radioulnar joint instability, if it is associated with fibrocartilagenous disc detachment then anatomical repair and dorsal or volar ligamentous restoration should be considered (Greenberg, 2009). With chronic instability, there is often a paucity of autologous tissue. This has lead to the development of a variety of techniques resulting in successful joint reconstruction (Adams and Lawler, 2007).

With rheumatoid arthritis of the distal radioulnar joint, the Darrach procedure has yielded satisfactory results (George et al, 2004). In younger, higher demand patients, the importance of retaining the ulna head is recognized. The hemiresection-interposition technique limits excision to abnormal tissue only. The Sauve–Kapandji technique combine distal radioulnar arthrodesis with preservation of the ulna head. Replacement of the distal ulna is becoming more popular. As with all surgical modalities, patient choice is of the utmost priority (*Figures 6* and *7*).

Figure 5. Carpo-metacarpal joint arthroplasty.

Kienböck disease: avascular necrosis of the lunate

Despite its early description in 1910 by Robert Kienböck (Peltier, 1980), the exact aetiology of the condition is still unknown. The disease progresses through stages as first described by Stahl and modified by Lichtman and Degnan (1993). With advancement of the condition, patients describe additional symptomatology:

- A painful and sometimes swollen wrist
- Reduced range of motion

Figure 6. Triangular fibrocartilage magnetic resonance image.

Figure 7. Distal ulna replacement.

- Decreased grip strength
- Specific overlying bony tenderness
- Inability to perform wrist extension.

In the early stages of Kienböck's disease, signs and symptoms mimic those of simple ligamentous injury. Among mechanical factors, a short ulna has been hypothesized to be the most relevant (Lluch and Garcia-Elias, 2011). This has lead to recommendations of radial shortening (Altay et al, 2008) or ulna lengthening (Quenzer and Linscheid, 1993).

Non-operative treatment has been shown to be beneficial with little evidence to support superiority of any particular form of operative action (Schuind et al, 2008). Surgical treatment is divided into reconstructive and salvage options according to disease progression and subsequent arthritic changes. Radial shortening and ulna lengthening have been adopted when potential for preservation of lunate vascularity still exists. Newer techniques have seen the advent of vascularized bone graft insertion as a means of maintaining lunate vascularity. Advanced disease can be treated with proximal row carpectomy or arthrodesis (*Figure 8*).

Other conditions

The following are a few common surgical conditions and their associated procedures available to the patient with wrist pathology.

De Quervain's disease

This is a tenosynovitis of the first extensor compartment which contains the extensor pollicus brevis and abductor pollicus longus tendons. Treatment often involves rest, elevation and analgesia. If symptoms persist, steroid injection and ultimately surgical decompression can be used.

Figure 8. Kienböck's disease.

Ganglions

These are cystic myxomatous degenerations of fibrous tissue. They are commonly found around the wrist joint and often originate from the scapholunate ligament. If painless, a non-surgical approach can be adopted. If they cause significant pain on movement, they can be aspirated and injected with steroid. This does not guarantee eradication and referral to a surgeon may be required. Patient education is important as excision carries a 20% risk of recurrence.

Surgical options

Total wrist arthrodesis

With severe arthritis and involvement of all carpal bones, this is an often adopted surgical treatment (*Figure 9*). The need for long-term immobilization has decreased with the advent of pre-contoured plates. Wrist arthrodesis has been consistently demonstrated to be beneficial as a pain-relieving measure. However, common pitfalls include missed concomitant distal radioulnar joint and ulnocarpal abnormalities (Hastings et al, 1996).

Total wrist arthroplasty

Total wrist arthroplasty is advantageous in terms of pain relief while allowing movement preservation. Implants have been available for approximately the last 40 years but long-term data have demonstrated a high incidence of implant failure in the first generations of these implants (Stanley and Tolat, 1993). Newer generations of articulated wrists have improved (*Figure 10*).

Figure 9. Total wrist arthrodesis.

Scaphotrapezio-trapezoid fusion

Arthritis of the scaphotrapezio-trapezoid joint presents with deep thenar eminence and base of thumb pain. It is often coexistent with carpometacarpal arthritis of the thumb and is a common site of arthritis particularly in women. Scaphotrapezio-trapezoid fusion has been recommended as an adequate procedure for scaphotrapezio-trapezoid osteoarthritis with regard to reduction of pain, maintenance of strength and preservation of movement.

Four corner fusion (capitate-lunate-hamate triquetrum) arthrodesis

Used for patterns of arthritis in the scapho-lunate advanced collapse and scaphoid non-union advanced collapse of the wrist, the four corner fusion involves complete excision of the scaphoid with an arthrodesis of the remaining carpus, i.e. the capitate, lunate, hamate and the triquetrum. Risks of the procedure involve non-union and dorsal impingement.

Proximal row carpectomy

In this technique, the entire proximal carpal row, i.e. the scaphoid, lunate and the triquetrum, is removed. It can only be offered in those where no arthritic changes are witnessed in the head of the capitate. Used as a salvage procedure, it has provided excellent results. A large percentage of grip strength and range of motion is preserved, some 80% and 60% respectively (Talwalkar et al, 2008). The arthritic disease process does continue, however, with degenerative changes seen at the radio-capitate. Hence, if this procedure is performed in younger patients, degenerative change is often later unveiled.

Figure 10. Total wrist arthroplasty.

Conclusions

Many conditions can lead to pain and functional deficit of the wrist. Establishing whether systemic factors are also involved is crucial when devising management plans. When an underlying diagnosis is established, optimal surgical intervention can be adopted. Diseases of the wrist can lead to significant degenerative change. Current surgical treatment options have lead to disease control and substantial functional improvements, culminating in considerable positive changes in quality of life. BJHM

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KEY POINTS

- Preoperative history and examination are essential to assess functional deficit and ascertain the underlying aetiology of presenting signs and symptoms.
- A multidisciplinary team approach must be adopted when embarking on surgical intervention. This includes a hand therapist and rheumatologist where necessary.
- When assessing wrist pain, one must always be vigilant in order to ensure surgical intervention is not undertaken in those with referred pain from the spine and/or elbow.
- Many ignore trivial injuries, but further medical advice must be sought in cases of ongoing wrist pain leading to functional deficit.
- Adequate preoperative patient education is paramount when contemplating a surgical approach. Patients face a long course of postoperative immobilization and rehabilitation.

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