Carpal Tunnel Syndrome and Median Nerve Lesions

Carpal tunnel syndrome (CTS) is by far the most common cause of median nerve damage. The reported prevalence of CTS in European populations is about 5%\cite{1}. The incidence of CTS peaks in the late 50s, particularly in women, and the late 70s, when the sex ratio is more equal.

The carpal tunnel is an anatomical compartment of the hand; it is bounded on three sides by carpal bones which form an arch, and on the palmar side by the transverse carpal ligament.

Pathogenesis\cite{1}

CTS is caused by compression, entrapment or irritation of the median nerve within the carpal tunnel at the wrist, between the carpal bones and the fibrous flexor retinaculum. Anything that causes a reduction in the volume or increases the pressure within the compartment may cause CTS.

Rarely, compression of more proximal parts of the nerve can occur at the forearm or elbow. The two significant conditions are pronator teres syndrome and anterior interosseous syndrome.

Aetiology

Most cases of CTS are idiopathic. However, it may be associated with\cite{1}:

- Pregnancy.
- Overuse of the hand or wrist.
- Wrist trauma.
- Obesity.
- Hypothyroidism.
- Renal failure.
- Diabetes.
- Inflammatory arthropathy.

Other potential underlying causes include:

- Post-Colles’ fracture.
- Flexion/extension injury of the wrist.
- Use of walking aids.
- Conditions encroaching on the space within the carpal tunnel (eg, aneurysm, neurofibroma, haemangioma, lipoma, ganglion, xanthoma and gouty tophi).
- Menopause (including surgically induced).
- Inflammatory arthropides of the wrist.
- Acromegaly.
- Renal dialysis.
- Amyloidosis.

There is also evidence for a genetic component, although the exact basis of this has not been established.

Other median nerve lesions

The main risk factor is occupational - eg, dentists and shipyard workers using high-powered vibrating tools.

Presentation

Carpal tunnel syndrome

CTS is characterised by tingling, numbness, or pain in the distribution of the median nerve (the thumb, index, and middle fingers, and medial half the ring finger on the palmar aspect) that is often worse at night and causes wakening. The affected hand may be hung out of the bed at odd angles to try to revive it. Pain may become more persistent, and may radiate to the forearm, elbow, arm and even the shoulder.

Weakness may be noted in hand grip and opposition of the thumb. There may also be some muscle wasting of the thenar eminence in more severe cases.

- Positive Phalen test: flexing the wrist for 60 seconds causes pain or paraesthesia in the median nerve distribution.
Positive Tinel’s sign: tapping lightly over the median nerve at the wrist causes a distal paraesthesia in the median nerve distribution.
Positive carpal tunnel compression test: pressure over the proximal edge of the carpal ligament (proximal wrist crease) with thumbs causes paraesthesia to develop or increase in the median nerve distribution.

The symptoms of CTS have been estimated to be bilateral in up to 73% of cases, although they may not present at the same time. If axonal injury occurs secondary to prolonged ischaemia, the nerve dysfunction may become irreversible.

Other median nerve lesions
Nerve damage at the elbow or forearm causes inability to flex the index finger and distal phalanx of the thumb with weak flexion of the middle finger and defective opposition of the thumb. This has been described as ‘simian’. There may be significant sensory loss over the palm and some fingers, with skin becoming dry, reddened and atrophic. With partial lesions, causalgia may develop hours or days later with dry scaly skin.

Differential diagnosis

Carpal tunnel syndrome
Other conditions which should be considered include:
- Other median nerve compression syndromes.
- Cervical radiculopathy.
- Shoulder bursitis.
- Thoracic outlet syndrome.
- Transient ischaemic attack.
- Tendonitis.
- Fibrositis.
- Lateral epicondylitis.
- Pronator syndrome - this is compression of the median nerve where it passes between the two heads of the pronator teres, causing pain in the wrist and forearm and weakness of the thenar muscles
- Anterior interosseous syndrome - compression mainly of the motor nerve, most commonly caused by tendinous origin of the deep head of the pronator teres, causing difficulty moving the index and middle fingers.

Investigations
Complex investigations are not necessary before starting conservative treatment in clinically obvious cases. However, in cases of diagnostic doubt, and before surgery, nerve conduction studies should be considered. Investigations are useful in patients whose clinical features yield a high index of suspicion for CTS but who fail to respond to first-line treatment.

- Electroneurography (ENG) - this is the gold-standard investigation for CTS. The median nerve is stimulated proximal to the carpal ligament and compound muscle action potential is picked up over the thenar eminence.
- Electromyography (EMG) - this is useful in some cases but is not as sensitive as ENG.
- Ultrasonography - this is being used increasingly as a confirmatory test. It is obviously relatively cheap, quick and non-invasive.
- MRI scan - this can be used as an alternative to ultrasonography and when electrophysiological studies are ambiguous. CTS can be classified into three groups according to the nerve T2 signal and the flattening ratio at the hook of hamate level: Group 1 - high and oval; Group 2 - high and flat; Group 3 - low and flat.

Management
Conservative management may be successful for early or mild disease or where advanced disease is associated with minimal symptoms. If non-operative strategies fail, open carpal tunnel decompression provides good results and high levels of reported satisfaction for most patients.

General measures
- Explain that the symptoms may resolve within six months. This is most likely to occur in young people (less than 30 years of age) if the symptoms are unilateral and of short duration, and in women in whom fluid retention due to pregnancy is the precipitating factor.
- There is limited evidence that a splint worn at night is more effective than no treatment in the short term, but there is insufficient evidence regarding the effectiveness and safety of one splint design or wearing regimen over others and of splint over other non-surgical interventions for CTS. However, splints are often beneficial for many patients.
- Advise minimisation of activities that exacerbate symptoms.
- There are no data to support that non-steroidal anti-inflammatory drugs (NSAIDs) are superior to placebo in the treatment of CTS. However, in absence of contra-indications, a trial of NSAIDs may be appropriate and may be beneficial.
- Consider referring patients when the diagnosis is uncertain or where treatments have failed to work after three months. In addition, patients with severe symptoms, especially if there is motor weakness of the thumb or persistent sensory or motor disturbance, should also be referred.
Corticosteroids
- Local steroid injections are widely used for diagnostic and therapeutic purposes in the management of CTS.
- One study has demonstrated that the response to steroid injection was around 70% after one month. Those with less severe nerve compression shown on MRI scan were more likely to respond compared to those with more severe compression[2].
- A recent randomised, placebo-controlled trial has shown that methylprednisolone injections for CTS have significant benefits in relieving symptoms at ten weeks and reducing the rate of surgery one year after treatment[6]. However, around 75% of patients still had surgery within one year.
- Another study has shown that both local steroid injection and surgical decompression are effective treatments in alleviating symptoms in people with CTS at two-year follow-up[6].

Surgical
- Surgical treatment consists of the release of the nerve by cutting the transverse carpal ligament. This can be done either with an open approach or endoscopically.
- Although surgery usually produces good outcomes, it has disadvantages, which are mainly surgery-related pain, hand weakness, and complications from surgery.
- The open approach and endoscopic approach for carpal tunnel release are about as effective as each other in relieving symptoms and improving functional status. Return to work is faster after endoscopic release, by eight days on average[7].
- Ultra-minimally invasive sonographically guided carpal tunnel release is a relatively new technique which preserves the superficial anatomy and diminishes the damage of a surgical approach[8]
- There are numerous rehabilitation treatments available after surgery. These include immobilisation using a wrist orthosis, dressings, exercise, controlled cold therapy, ice therapy, multimodal hand rehabilitation, laser therapy, electrical modalities, scar desensitisation and arnica. However, there is limited and, in general, low-quality evidence for the benefit of these[9].
- Following surgery, patients have been shown to return to work to modified duty at an average of 12 days and to full duty at an average of 19 days after surgery[10].

Other treatments
- Acupuncture has been shown to be beneficial and can improve symptoms, grip strength and electrophysiological function[11, 12]. Simple exercises, such as wrist bend, wrist lift and wrist flex, to help improve the patient’s strength and flexibility. Nerve glide exercises to improve the mobility of the median nerve. However, some exercises may exacerbate a patient’s symptoms.
- There is limited and very low-quality evidence of benefit for all of a diverse collection of exercise and mobilisation interventions for CTS[13]. There is only poor-quality evidence from very limited data to suggest that therapeutic ultrasound may be more effective than placebo for either short- or long-term symptom improvement in people with CTS[14].

Prognosis[15]
Symptoms can resolve within six months in about one third of persons, particularly younger patients. A poor prognosis is often associated with bilateral symptoms and a positive Phalen test. However, the severity of symptoms and signs often doesn't correlate well with the extent of nerve compression.

Further reading & references
1. Middleton SD, Anekwe RE; Carpal tunnel syndrome. BMJ. 2014 Nov 6;349:g6437. doi: 10.1136/bmj.g6437.