Carpal tunnel syndrome

Carpal tunnel syndrome is an entrapment median neuropathy affecting up to 1 in 20 individuals. Owing to recent NHS cuts, it has now been classified as a low priority procedure. This article discusses the diagnosis and management of this common clinical condition.

Carpal tunnel syndrome is the most common peripheral neuropathy with a reported incidence of 1–5% (Atroshi et al, 1999; Bongers et al, 2007). It was first described by Paget in 1854. Carpal tunnel syndrome is caused by compression or irritation of the median nerve within the carpal tunnel. It is most common in patients aged 45–65 years and has a female to male ratio of 3:1 (Bongers et al, 2007). It results from any space-occupying structure within the tunnel including tendinous thickening, synovitis, thickening of the flexor retinaculum, fluid and lesions.

There is conflicting evidence in the literature about the diagnosis and treatment of carpal tunnel syndrome. There are thousands of published studies on the subject but most are poor quality (level IV and V evidence) and often compare heterogeneous groups with small sample sizes.

With recent government spending cuts, certain procedures will be less readily available on the NHS. The treatment of carpal tunnel syndrome may be limited by these reforms. Guidelines have been published by both the British Society for Surgery of the Hand (2011) and the American Academy of Orthopaedic Surgeons (2007, 2008) on the diagnosis and treatment of carpal tunnel syndrome. It is important that these are followed to ensure optimal care for all.

Anatomy

The carpal tunnel is found at the distal volar wrist crease (*Figure 1*). It is bound dorsally by the arch of carpal bones and the roof is formed by the flexor retinaculum. Medially the tunnel is bound by the hook of hamate, the triquetrum and the pisiform bones and laterally it is bound by the scaphoid, trapezium and flexor carpi radialis sheath. Within the tunnel are the median nerve together with the tendons of flexor digitorum superficialis, flexor digitorum profundus and flexor pollicis longus. The median nerve supplies sensation to the radial three and a half digits and motor function to the muscles of the thenar eminence.

Presentation

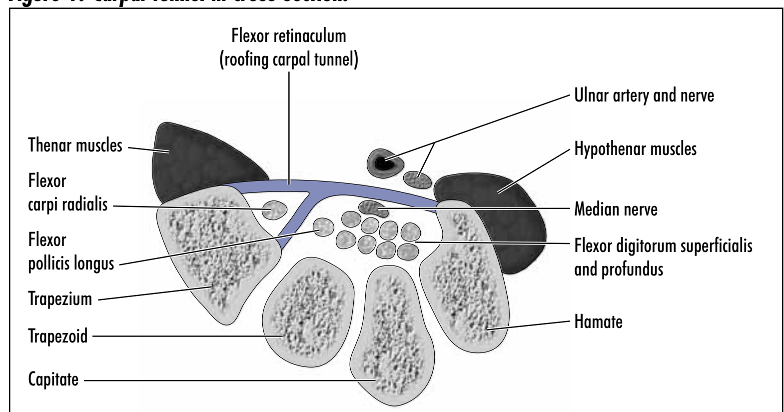
The typical presentation of carpal tunnel syndrome is pain, paraesthesia and numbness in the median nerve distribution of the hand. Pain is often worse at night and when gripping objects for a length of time, such as the telephone. Patients frequently report that the pain improves when they shake their hand. As the disease progresses, pain may develop in the forearm and patients often report weakness of the thumb and a propensity to drop things. Untreated, carpal tunnel syndrome can ultimately lead to permanent sensory loss and paralysis of the thenar muscles.

Based on symptoms alone, the British Society for Surgery of the Hand (2011) has classified carpal tunnel syndrome into mild, moderate and severe. In mild carpal tunnel syndrome there is intermittent paraesthesia. This may be nocturnal, associated with certain hand positions or associated with conditions such as pregnancy or hypothyroidism. In moderate carpal tunnel syndrome there is constant paraesthesia which interferes with activities of daily living and wakes patients from sleep. There is associated reversible numbness and/or pain. In severe carpal tunnel syndrome there is constant numbness or pain associated with weakness and/or wasting of the thenar muscles.

Examination

Carpal tunnel syndrome can largely be diagnosed on history alone but there are some common clinical signs. Neurological examination often reveals altered sensation in the radial three and a half digits. The exact distribution of sensory changes can be established using two-point discrimination, Semmes–Weinstein monofilament

Figure 1. Carpal tunnel in cross section.



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testing or vibrometry. There may be weakness of the thenar muscles, with or without wasting.

There are two well-known provocative tests for carpal tunnel syndrome. Tinel's test is the reproduction of paraesthesia in the hand on tapping over the median nerve at the distal wrist crease. Phalen's test involves complete volar flexion of the wrist within 1 minute. Paraesthesia in the median nerve distribution indicates a positive test result. Reports of the sensitivity and specificity of these tests vary (de Krom et al, 1990; Katz et al, 1990). A 'gold standard' test has not yet been established.

A careful examination of the cervical spine and the rest of the upper limb is important to exclude other conditions with similar symptoms to carpal tunnel syndrome such as base of thumb osteoarthritis, de Quervain's tenosynovitis, cubital tunnel syndrome and cervical radiculopathy.

Causes

Certain conditions predispose to carpal tunnel syndrome including rheumatoid arthritis, obesity, pregnancy and hypothyroidism. These all lead to compression of the median nerve within the tunnel. Diabetes and alcoholism can also present with the symptoms of carpal tunnel syndrome but this is often the result of damage to the nerve itself. Therefore, decompression may not lead to any improvement.

Carpal tunnel syndrome tends to run in families and research has shown there is a strong hereditary component. This may be caused by the inheritance of abnormal carpal tunnel anatomy, or by the inheritance of an inflammatory condition.

There is much debate as to whether occupational activities predispose to carpal tunnel syndrome. There is now a general consensus that heavy manual work and work with vibrating tools can predispose to the condition (Nathan et al, 2005). Repetitive lighter work, such as keyboard use, is not associated with carpal tunnel syndrome (Atroshi et al, 2007).

Anatomical factors can cause carpal tunnel syndrome. A wrist fracture or dislocation that alters the space within the carpal tunnel will lead to compression of the median nerve. The higher incidence of the condition in women compared to men may be because the carpal tunnel is relatively smaller in females.

Investigations

Electrophysiological testing includes both nerve conduction studies and electromyography. Both tests are commonly used to diagnose carpal tunnel syndrome and grade the disease as mild, moderate or severe. Nerve conduction studies and electromyography studies have been shown to be both sensitive and specific (Chang et al, 2008). However, results from these tests are dependent on the skill of the practitioner. There are multiple factors including age, sex, obesity and temperature that can produce erroneous results. These factors need to be taken into account when interpreting reports.

Controversy remains as to which patients need electrophysiological studies. The British Society for Surgery of the Hand (2011) suggests these tests should be reserved for equivocal cases, to exclude neuropathy, if symptoms persist after carpal tunnel release and in medicolegal cases. The American Academy of Orthopaedic Surgeons (2007) recommends electrophysiological testing for all patients with positive clinical or provocative tests where surgery is being contemplated.

Ultrasound and magnetic resonance imaging have been used to diagnose carpal tunnel syndrome but there is no good evidence supporting their routine use. They may be beneficial when a space-occupying lesion is suspected.

All patients with carpal tunnel syndrome should undergo routine blood tests to exclude diabetes and hypothyroidism. If appropriate, pregnancy should also be excluded.

Treatment

Treatment of carpal tunnel syndrome can be non-surgical or surgical. Non-surgical options include the use of wrist splints, steroid medication, steroid injections, ultrasound and activity modification.

Wrist splints restrict movement and hold the wrist in a neutral dorsi-palmar flexion (*Figure 2*), at a point where the pressure in the carpal tunnel is at its lowest. They are effective in controlling symptoms, if intermittent in nature, and often reduce pain, particularly when worn at night (Premoselli et al, 2006). Splintage is extensively used in the USA for patients with mild to moderate symptoms before referral to hospital, compared to its use in the UK (Burke et al, 2007).

Steroid injections proximal to the wrist crease have been shown to improve symptoms (Gokoglu et al,

Figure 2. Patient wearing a wrist splint.

2005). However, there is a small risk of damage to the nerve. In the 2007 Cochrane review (Marshall et al, 2007), local steroid injections were shown to relieve symptoms in many studies, but this was time-limited to 1 month, with no further benefit from serial injections. Steroid injections are less effective in diabetics, the elderly, those with severe symptoms and those with a long history. Oral steroids have been shown to be less effective than steroid injections (Marshall et al, 2007) and oral anti-inflammatory medication does not provide any benefit (O'Connor et al, 2003).

There is some evidence that both hand therapy (Storey et al, 2007) and ultrasound treatment (O'Connor et al, 2003) can lead to an improvement in symptoms. Hand therapy usually involves median nerve gliding exercises, carpal bone mobilization and activity modification. None of the conservative measures mentioned above provide symptom relief for longer than 2 months when compared to a control population (O'Connor et al, 2003).

Surgery involves complete division of the flexor retinaculum to release the median nerve. There are different surgical techniques for performing a carpal tunnel decompression but there is no evidence that one technique is superior to any other (Verdugo et al, 2003). Surgery is a very effective treatment for patients with carpal tunnel syndrome (Hui et al, 2005).

The standard open carpal tunnel release involves releasing the flexor retinaculum under direct vision ensuring a safe and complete release. It is the oldest and most commonly used technique. It can be performed under local anaesthetic and normally takes less than 15 minutes. The most common associated morbidity with this procedure is scar pain and sensitivity. The sensitivity usually resolves over a few months. This problem encouraged surgeons to develop less invasive techniques.

The mini-open release involves a 1–1.5 cm incision at the distal wrist crease. Special instruments have been developed to allow division of the retinaculum with limited access. Carpal tunnel release can be performed endoscopically. Several methods have been reported including a single and double portal technique. Both methods use an endoscope to visualize the under surface of the flexor retinaculum and guide the surgeon's knife. Patients have a smaller scar and may make a quicker recovery. However, there is no long-term difference in outcome between open and endoscopic release (Verdugo et al, 2003).

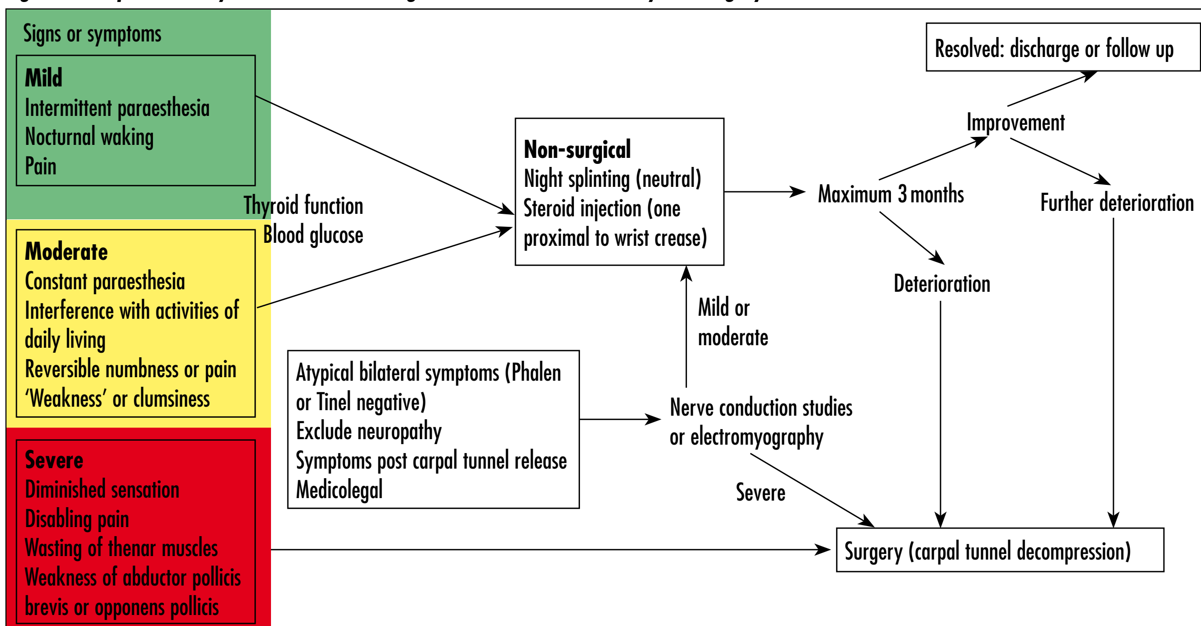
A risk of mini-open and endoscopic techniques is incomplete release of the flexor retinaculum as a result of poor visualization. This results in persistent symptoms. The decision as to whether to perform an open, mini-open or endoscopic carpal tunnel decompression should be guided by both the surgeon's experience and the patient's preference.

Ashworth (2011) reviewed the clinical evidence surrounding non-operative treatments for carpal tunnel syndrome. The research into this topic is poor quality, as there have been no randomized controlled trials on some therapies, or they have been too small to draw a reliable conclusion. Further research in the community setting is recommended.

Across the NHS primary care trusts have now classed mild to moderate carpal tunnel syndrome as a low priority procedure as a result of the limited clinical and/or cost-effective evidence. Low priority procedures are those unlikely to have significant adverse effect on a patient's quality of life. Patients with mild to moderate symptoms will not be referred on to tertiary care without trialling conservative treatment for 3 months (Ashworth, 2011).

The British Society for Surgery of the Hand (2011) (*Figure 3*) recommends conservative treatment for

Figure 3. Carpal tunnel syndrome treatment algorithm. From British Society for Surgery of the Hand (2011).



patients with mild and moderate disease (based on symptoms or electrophysiological testing). This treatment can be provided in the primary care setting. Conservative measures should be continued for a maximum of 3 months. If improvement is noted, the patient can be discharged. If the symptoms remain unchanged or deteriorate over 3 months, the patient should be referred to a tertiary centre for surgical decompression. Severe cases (based on symptoms alone) should be referred for surgical decompression as a first-line treatment. The elderly, diabetic patients and patients with rheumatoid arthritis should also be considered for immediate surgery rather than a trial of conservative treatment.

The American Academy of Orthopaedic Surgeons (2008) suggests that non-surgical treatment is an option in all patients diagnosed with carpal tunnel syndrome. If no improvement is seen within 2–7 weeks, they recommend a trial of another non-surgical treatment or surgery. Surgery is recommended if non-surgical treatments fail, if there is clinical evidence of median nerve denervation or if the patient elects to have surgery as a first-line treatment.

Recurrent carpal tunnel syndrome

Recurrent carpal tunnel syndrome is rare and may be the result of incomplete release, pathology of the nerve itself, scar formation, the presence of an enlarging mass or an incorrect initial diagnosis. The cause of the recurrence should be investigated with electrophysiology studies and ultrasound or magnetic resonance imaging before embarking on revision surgery. An open decompression must be performed and flaps may be necessary to ensure creation of a large enough space for the nerve to reside in.

Conclusions

Carpal tunnel syndrome can be diagnosed on history and examination findings. Confirmation can be gained from electrophysiology studies. Mild and moderate carpal tunnel syndrome can initially be treated with conservative measures for 3 months. If these fail, surgery should be considered. Severe cases should have surgical release as a first-line treatment. These guidelines should be followed to ensure that all patients receive optimal care. **BJHM**

KEY POINTS

- Carpal tunnel syndrome is the most common peripheral neuropathy.
- A typical presentation is paraesthesia, numbness and pain in the hand associated with weakness.
- Examination may reveal wasting, altered sensation in the hand and positive provocative tests.
- Carpal tunnel syndrome can be diagnosed on clinical grounds alone. In certain cases, electrophysiological tests may be necessary for confirmation.
- Treatment includes both non-surgical and surgical options.
- Mild and moderate carpal tunnel syndrome should be treated initially with conservative measures. If these fail within 3 months, surgery should be considered.
- Severe carpal tunnel syndrome should be treated with surgical release as a first-line treatment.

Conflict of interest: none.

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