

International Encyclopedia of Rehabilitation

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Carpal Tunnel Syndrome

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Carpal tunnel syndrome is an upper limb entrapment neuropathy which may result in motor and sensory disturbance of the median nerve. It is one of the most common entrapment neuropathies and can be managed with varying conservative approaches or with surgical decompression. Lasting impairment may be evident in severe cases and may require intervention from members of the allied health professions to assist with optimum performance in work and leisure activities.

What is carpal tunnel syndrome?

The carpal tunnel is an anatomical compartment at the base of the wrist. It is bound on three sides by the carpal bones which form an arch and is enclosed by the flexor retinaculum. The retinaculum is attached to the pisiform and hamate on the ulnar side and to the scaphoid and trapezium on the radial side (Abrahams et al. 2005).

The median nerve and the nine extrinsic flexors of the fingers and thumb pass through the carpal tunnel beneath the Palmaris longus tendon. The median nerve supplies sensation to the palmer aspect of the radial 3.5 digits and the ends of the fingers on the dorsal aspect of the same digits. The median nerve also provides motor innervation to the muscles of the thenar eminence, particularly the abductor pollicis brevis (abducts the thumb) and the opponens pollicis (flexes, adducts and medially rotates the thumb) (Abrahams et al. 2005, Barnardo, 2004).

Carpal tunnel syndrome is a collection of symptoms that occur when there is compression of the median nerve. Intermittent or sustained high pressure within the carpal tunnel due to reduced dimensions of the tunnel, or the increased volume of its contents may result in ischaemia of the median nerve. This results in the impairment of the median nerve conduction and consequently causes paraesthesia and pain within the median nerve distribution.

Carpal tunnel syndrome (CTS) is one of the most common upper limb neuropathies and accounts for approximately 90% of entrapment neuropathies (Aroori and Spence 2008). Prolonged pressure on the median nerve may lead to focal demyelination and result in more constant/severe symptoms such as weakness and wasting within the affected hand. If axonal damage occurs due to prolonged ischaemia then nerve dysfunction may become irreversible. Lasting nerve damage may result in permanent loss of function to the median nerve and consequently may have significant impact on work and leisure activities.

Prevalence

CTS occurs more frequently in those aged over 40 years (Tiedeman, 2004) and is reported by to have an annual incidence of 139 cases per 100,000 females and 67 per 100,000 males (Bland et al. 2003). CTS is also commonly experienced by women during

their menopause and during pregnancy due to water retention. Although CTS symptoms generally resolve following childbirth, Mondelli et al. (2007) have noted that approximately 50% of these women may still have mild symptoms 3 years following childbirth.

Characteristics

CTS produces a range of symptoms that can range from mild to severe and is characterized by tingling, pins and needles, numbness, pain or burning sensations along the median nerve distribution. Pain may often be reported as being worse at night and cause waking; this can be caused by the position of the hands during sleep, which consequently may provoke the symptoms. Relief from symptoms may be obtained by changing hand position or shaking the wrist. The use of a wrist splint at night helps to maintain the wrist in a neutral position without applying direct pressure to the carpal tunnel and consequently reduces the potential to stretch the nerve and therefore alleviates the symptoms (Kanaan and Sawaya 2001; Bland 2007).

The dominant hand is more frequently affected by CTS although it is not uncommon for both hands to be affected, especially if there is a constitutionally narrow canal. Symptoms are often exacerbated by sustained hand/arm positions or repetitive actions of the hand and wrist. Other symptoms of CTS may include a dull aching or discomfort in the hand or forearm. Patients may report a weak grip or clumsiness of fine finger movement and/or reduced manual dexterity which may cause the individual to drop things. In severe cases there may also be apparent weakness particularly of the thumb.

Physical examination of the hand may be normal, although there may be sensory loss in the median nerve distribution and in some cases dry skin of the thumb, index and middle fingers, although no changes in sensation to the hypothenar element of the palm, as this area is not supplied by the median nerve. As the median nerve carries both motor and sensory fibres there may be noticeable weakness and/or wasting of the thenar eminence. It should be noted that thenar atrophy is a late sign and indicates significant functional loss. On examination thenar atrophy is more readily noticed when comparing both palms together.

Special tests for CTS may include Phalen's test or Tinnels sign. Phalen's test causes compression of the median nerve through flexion of the wrist; in a positive test this reproduces the patient's symptoms such as pain and paraesthesia in the median nerve distribution. Similarly, a positive Tinnel's sign causes tingling or discomfort within the digits supplied by the median nerve when the site of the median nerve is percussed at the wrist.

What causes CTS?

Any condition, trauma or injury which increases the pressure on the median nerve within the carpal tunnel may cause CTS. There is a strong genetic predisposition towards CTS (Hakim et al. 2002) and a positive family history in parents or siblings in 1 in 4 people with CTS (Clinical Knowledge Summaries 2008, Barnardo 2004). Non-specific tenosynovitis is one of the most common causes of increased canal contents (Teidman,

2004); however, there are many other factors which may be associated with CTS. Conditions which may be associated with CTS include inflammatory diseases (e.g. rheumatoid arthritis), connective tissue disorders (e.g. systemic lupus erythematosus) or metabolic causes (e.g. hypothyroidism, diabetes mellitus) which should be excluded prior to making the diagnosis of CTS. Other underlying contributory causes may include trauma such as a Colles' fracture or a fracture dislocation of the radiocarpal, carpal or carpometacarpal joints. Increased canal volume due to oedema may also occur as a direct result of trauma to the local area. In many cases the cause of CTS is unknown (Clinical Knowledge Summaries, 2008).

The routine screening for coexisting disease in people with a new diagnosis of CTS is not recommended despite the higher prevalence of diabetes mellitus, hypothyroidism and rheumatoid arthritis in people with CTS (Van Dijk et al. 2003; Clinical Knowledge Summaries, 2008). Practitioners should however have a low index of suspicion before obtaining random blood sugars or thyroxine tests in new cases of CTS.

Differential diagnosis for CTS may include cervical radiculopathy particularly at the level C6/7, or generalized peripheral neuropathies. Multiple sclerosis, syringomyelia or brachial plexus injuries should also be excluded, although these are less common neurological conditions. Common vascular conditions to exclude are Raynaud's phenomenon, vibration white finger or cerebral infarction. Osteoarthritis of the metacarpophalangeal joint should also be considered as a potential differential diagnosis.

Diagnostic studies

Clinical diagnosis of CTS depends on the presence of median nerve signs and symptoms, although the use of electrodiagnostic studies such as nerve conduction studies or electromyography (EMG) may be beneficial to exclude neuropathy or other nerve entrapments (Bland, 2007, Katz and Simmons 2002). In nerve conduction studies a delay in the latency of the median nerve at the point of suspected compression signifies the compression or demyelination of the nerve. EMG testing can also be utilized to ascertain if there is a delay in latency of the motor unit action potential (muscle). If it is suspected that a tumor, fracture or arthritis are considered to be possible causes of median nerve compression then X-rays should be obtained.

Management

Symptoms may spontaneously resolve in some individuals, particularly if the individual is under 30 years of age and with short duration of symptoms, or if they are pregnant (Clinical Knowledge Summaries, 2008). Spontaneous remission of CTS was noted in 35% of patients after an average time of 6 months (Futami et al. (1997). The presence of a positive Phalen's test or bilateral symptoms is considered to be poor prognostic signs for a natural recovery (Padua et al. 2001). The purpose of treatment is to alleviate symptoms and where possible prevent the worsening of the condition. Treatment focuses on the decompression of the median nerve within the canal.

Conservative management of CTS can simply involve eliminating, or greatly reducing the movements and tasks which seem to exacerbate the symptoms, for example repetitive

movements of the wrists and fingers or extremes of flexion/extension of the wrist; although this may not be possible in some types of occupation. The use of a wrist splint to maintain the wrist in a neutral position is one of the initial steps which can be taken to address CTS symptoms. Wrist splinting is effective in many patients and improvement is usually evident by 8 weeks (Clinical Knowledge Summaries, 2008). There is limited evidence in support of ergonomic adjustments within the workplace to help relieve CTS symptoms (Verhagen et al. 2006), however appropriate modifications may include altering the users or the object position in order to reduce excessive wrist flexion or extension. The use of ergonomic equipment may similarly facilitate the use of correct posturing and alignment to assist with this. Using a relaxed grip and avoidance of gripping too hard when driving, writing or using hand tools again may help alleviate the symptoms of CTS and regular breaks should be encouraged when performing repetitive tasks.

Non steroidal anti-inflammatory drugs or diuretics are not effective in the ongoing management of CTS and therefore routine uses of these drugs are not recommended. If CTS is attributed to an inflammatory arthritis such as rheumatoid arthritis then management of the underlying condition should relieve the carpal tunnel symptoms (Katz and Simmons, 2002). Local corticosteroid injections to the carpal tunnel may provide short term improvement in symptoms and are often of great benefit to patients, providing significant improvement of symptoms for up to three months (Marshall et al. 2007). At present there is little evidence to support the use of more than one corticosteroid injection (Marshall et al. 2007) as patients often demonstrate no further clinical improvement when compared to those who had the singular injection (Wong 2005). The main risk associated with local corticosteroid injection is the potential for the median nerve to be injected, which may lead to axonal and myelin degeneration (Haase, 2007). The risk of median nerve damage from intraneural injection is however very small and has been estimated to be <0.1% when performed by an experienced health care professional (Bland, 2007).

Whilst conservative treatments can be very effective in relieving CTS symptoms, in severe cases or where conservative treatments have been unsuccessful in relieving symptoms, surgical intervention may be necessary. Although splinting has been reported to have a success rate of 37% at 18 months, surgery is more successful in relation to general improvement, severity of symptoms and number of nights waking up due to symptoms (Gerritsen et al. 2002).

Operative management involves the decompression of the carpal tunnel by dividing the retinaculum. This decreases the pressure within the carpal tunnel and reduces the pressure on the median nerve. Following surgery the symptoms should resolve, however in severe cases where damage has occurred to the median nerve there may be lasting paraesthesia or weakness. Surgery may be carried out by standard open carpal tunnel release or with the use of less invasive endoscopic technique. Scholten et al. (2007) report that both methods are effective procedures for the short and long term relief of symptoms, however, endoscopic carpal tunnel release allows an earlier return to normal activities of daily living and facilitates an earlier return to work.

Complications of surgery may include incomplete release of the retinaculum, injury to the median nerve, reflex sympathetic dystrophy, finger stiffness, weakness, infection and scar tenderness (Tiedman, 2004). Post operative complications such as infection, hypertrophic scar and scar tenderness are noted to be more common in patients who have undergone an open carpal tunnel release, whereas neuropraxia, numbness and paraesthesia are more likely to be experienced by those who undergo an endoscopic carpal tunnel decompression (Gerritsen et al. 2002).

The most commonly used method to quantify the effectiveness of treatment involves the use of self reported questionnaires such as the short form-36 (SF-36) to measure generic quality of life, or the Boston Carpal Tunnel Questionnaire which assesses function, activity and outcome measures (Aroori and Spence 2008).

CTS may pose many problems for patients, especially if work involves repetitive tasks, or tasks which provoke CTS symptoms. Close liaison with occupational health will assist the individual to adapt the work place to reduce provoking factors, or may be able to help with regards to returning to work following carpal tunnel surgery. In severe cases of CTS where lasting damage is thought to have occurred to the median nerve a thorough assessment of the patients activities of living should be carried out involving the appropriate members of the Allied Health Professions. Reduced grip strength may benefit from advice from occupational therapists and physiotherapists with regards to improving function and finding appropriate adaptations to manage with activities of daily living.

Conclusion

CTS is a problem which occurs due to compression of the median nerve within the carpal tunnel. Symptoms may be relived through appropriate conservative management which may include ergonomic arrangement of equipment, reduction of repetitive motion and splinting. If conservative management is unsuccessful or median nerve compression is severe then surgical decompression offers successful management of CTS symptoms. An understanding of what the carpal tunnel is and how carpal tunnel syndrome may be managed allows patients to self-manage the condition where appropriate and enables health care professionals to offer appropriate care and reassurance to patients in different occupational and health care settings.

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