



W Bruce Conolly AM

FRCS, FRACS, FACS, is Associate Professor of Hand Surgery and Conjoint Appointee, University of New South Wales, Clinical Associate Professor, University of Sydney, and a hand surgeon, Sydney Hospital, New South Wales.

John H McKessar

FRACS, is a hand and upper limb medicolegal consultant, Sydney, New South Wales.



Carpal tunnel syndrome

Can it be a work related condition?

Background

Carpal tunnel syndrome is one of the most common hand conditions seen in clinical practice. Many in the workforce, both male and female, will develop carpal tunnel syndrome and many will claim that their workplace has caused their condition.

Objective

This article seeks to guide the examining practitioner in answering the questions of patients and insurance companies as to whether a patient with the established diagnosis of carpal tunnel syndrome has an acceptable workers' compensation claim for treatment.

Discussion

Carpal tunnel syndrome is mostly constitutional and due to intrinsic factors such as genetics, body weight, and endocrine and rheumatoid disease. Extrinsic and work related factors such as forces applied to the wrist, and working in cold temperatures and with vibrating equipment will also be discussed.

■ **Carpal tunnel syndrome (CTS) – compression of the median nerve in the carpal tunnel (Figure 1) – manifests with numbness, pain and paresthesia in the median nerve distribution, mostly at night, and is sometimes associated with thenar muscle weakness. The painful burning, numbness and tingling may radiate up the arm to the shoulder or neck. The fingers may feel swollen and the entire arm may feel heavy.**

The syndrome most often occurs in adults aged 30–60 years or over. It is 4–5 times more common in females than males, and may involve either the dominant or nondominant hand or both hands. It is rare in childhood.

Pathogenesis of carpal tunnel syndrome

Median nerve compression may arise either from an increase in the contents of the carpal tunnel or a decrease in the size of the tunnel. Carpal tunnel syndrome may be acute, subacute or chronic. Increase in the contents can be due to conditions such as:

- flexor tenosynovitis and its variants
 - inflammatory
 - traumatic
 - gout and allied conditions
- acute swelling from injury (eg. Colles fracture)
- space occupying lesions (eg. simple tumours, cysts, abnormal tissue such as hypertrophy of musculature)
- bleeding into the canal.

In patients with CTS, the most significant clinical finding is the presence of a flexor tenosynovitis and this may be substantiated by ultrasound findings. The fluctuation in the clinical symptomatology of the condition is probably associated with a varying degree of swelling of the tenosynovium. At operation this clinical and ultrasound evidence of flexor tenosynovial swelling is not always evident.

Factors causing a decrease in the size of the canal may be either transient or permanent and may be:

- transient conditions – high range repetitive flexion and extension movements which diminish volume and increase pressure in the canal



- permanent conditions:
 - fracture dislocations of the canal walls
 - congenital narrowing (possibly familial)
 - connective tissue thickening (eg. scarring, flexor retinacular thickening).

Over and above these two mechanisms there are many contributing metabolic and endocrine factors. These include:

- rheumatic disease
- thyrotoxicosis myxoedema
- acromegaly
- hormonal – pregnancy and menopause
- diabetes mellitus
- obesity, particularly in association with diabetes.

What the literature says

There are widely divergent views in the literature as to the possible roles of work and constitutional factors in the aetiology of carpal tunnel median nerve compression.

Schuid et al¹ studied the tenosynovium of patients who had undergone carpal tunnel release and who had had clinical and electrophysiological resolution after surgery. They found the combination of fibrous hypertrophy, focal necrosis and serous bursae with no obviously inflammatory cells and surmised that repeated trauma due to friction of excessive flexor tendon movement caused tenosynovial fibrous degenerative hypertrophy.

This begs the question as to whether this thickened synovium could be a primary degenerative or metabolic phenomenon or whether it is, as they suggest, the endpoint of excessive flexor tendon movement; and, as in so much of the reporting on carpal tunnel aetiology, there is no simple answer to that question. However, thickened tenosynovium will certainly increase the carpal tunnel contents thereby increasing carpal tunnel pressure resulting in median nerve compression.

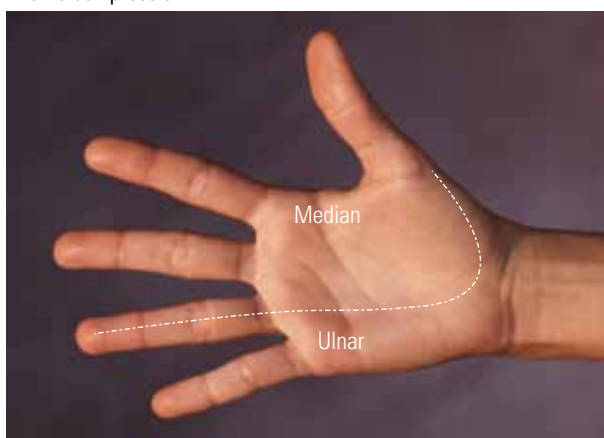
Szabo² reviewed a series of papers on CTS which argue for and against occupation being a significant risk factor in causation of CTS.

He stated that: 'Occupational risk factors alone do not explain the occurrence of carpal tunnel syndrome, rather carpal tunnel syndrome is the culmination of many converging causal factors'.

It has been stated that the risk of CTS is high in occupations involving exposure to high pressure, high force, repetitive work and vibrating tools.³ High repetition is defined either by the frequency of the task or the percentage of time spent on repetitive work. A high repetitive job is defined as one which involves the repetitive use of awkward wrist movements lasting more than 30 seconds or more, or when more than 50% of work time is spent performing tasks that involve awkward wrist movements.^{4,5}

Fung et al⁶ noted that a neutral wrist position and repetitive wrist motion was not associated with CTS, however frequent flexion and extension and sustained force of the wrist increases the risk of developing CTS. Smith⁷ noted that the flexed wrist increases carpal tunnel compression.

Figure 1. Commonest distribution of symptoms of median and ulnar nerve compression



On the other hand, Stapleton⁸ stated that CTS has nothing to do with occupation and is not related to repetitive movement. Dias et al⁹ came to the same conclusion.

The American Academy of Orthopaedic Surgeons¹⁰ also indicated that the causal link between CTS and repetitive use of the hands is much weaker than has been assumed. There is strong evidence of an inherited genetic risk for CTS. The cause of the increased pressure in the carpal tunnel remains unknown in the vast majority of patients.

With respect to keyboard use, Andersen et al¹¹ found no statistically significant association with keyboard use, and Stevens et al¹² noted the frequency of CTS in computer users was similar to that of the general population.

The American Academy of Orthopaedic Surgeons also stated that the average scores for biological factors (ie. genetics, race, age) were double those of occupational factors (occupation, repetitive use, vibration).¹⁰

The prevalence of CTS in the different occupational groups varied from 0.6–61%. The highest prevalence was noted in grinders, butchers, grocery store workers, frozen food factory workers, and platers and workers with high force, high repetitive manual movements.^{13–15}

Macfarlane¹⁶ in a large study of workers in France involved in repetitive work showed that people with poor psychological wellbeing who had low job control were most likely to develop symptoms.

Vender et al¹⁷ also was of the opinion that from strong epidemiological evidence the workplace plays a part in the causation of CTS.

Table 1 outlines the key occupational points to consider in determining work liability for CTS.

Medicolegal reporting

When giving a medicolegal opinion it must always be appreciated that the reporter is acting in a legal framework and must understand the legal implications of seemingly simple terms such as 'injury', 'aggravation', 'degeneration' and 'substantial'.

The reporter will be called upon to exercise his/her judgment as to whether a patient's work practices constitute a substantial



Table 1. Key occupational points in determining work liability

- High repetitive wrist movements
- High range wrist action
- Constant extreme wrist position (flexion or extension)
- Use of hand held vibratory equipment
- Work involving frozen food
- Availability of protection (eg. gloves)
- Lengthy exposure to the above
- Does the patient have constitutional factors known to increase the incidence of CTS?

contributing factor to their problem. The New South Wales *Workers Compensation Act* gives examples of matters to be taken into account for the purposes of determining whether a worker's employment is a substantial contributing factor to an injury. These include:

- the time and place of injury
- the nature of the work performed and the particular tasks of that work
- the duration of the employment
- the probability that an injury or similar injury would have happened anyway at or about the same time or at the same stage in the worker's life, if he or she had not been at work or had not worked in that employment
- the worker's state of health before the injury and the existence of any hereditary risks
- the worker's lifestyle and his/her activities outside the workplace.

In addition it states that this subsection of the Act does not limit the types of matters which can be taken into account for the purposes of such a determination.

The reporter may be called upon to exercise a judgment as to whether the aggravation caused by a work injury has ceased. This will remain essentially a judgment based on clinical experience, including knowledge of pathology demonstrated at operation and of specialised investigations such as ultrasound.

If from history and examination it has not been possible to rule out occupational factors as having a role in the development of the CTS, this must be stated clearly. This will be a measure of judgment as to whether specific practices identified in the history are accompanied by high strength, high flexion/extension wrist actions with repetition prevail in the patient's work. If so, then it can be stated that a worker's employment has been a substantial contributing factor to the injury.

There can be no 100% certainty. Each case must be considered on its merits.

From the above qualifications given in the Act, and from determination of the nature of a patient's work, it will be seen that there is nothing which gives a quantitative assessment as to what 'substantial' means. If it is assessed that a patient's work has been responsible for 25% of their overall impairment, a quantitative assessment on the concept of substantial has been made. This clearly indicates that a series of other factors may be contributing to the

patient's carpal compression. This is likely for all patients suffering from CTS.

Conclusion

In most cases CTS is a constitutional condition. However, in some patients, work activities generating increased force and pressure in the carpal tunnel over a lengthy period must be regarded as a substantial contributing factor to their CTS by the increase in carpal tunnel pressure. Prolonged work in cold conditions and prolonged work with vibrating equipment may also be a contributing or substantial factor in the production of CTS. Work related factors may coexist with any of the constitutional risk factors.

Conflict of interest: none declared.

References

1. Schuind F, Ventura M, Pasteels JL. Idiopathic carpal tunnel syndrome: Histologic study of flexor tendon synovium. *J Hand Surg Am* 1990;15:497–503.
2. Szabo R. Carpal tunnel syndrome as a repetitive motion disorder. *Clin Orthop Relat Res* 1998;351:78–89.
3. Aroori S, Spence RA. Carpal tunnel syndrome. *Ulster Med J* 2008;77:6–17.
4. Abbas MA, Afifi AA, Zhang ZW, Kraus JF. Meta-analysis of published studies of work related carpal tunnel syndrome. *Int J Occup Environ Health* 1998;4:160–7.
5. Wieslander G, Norback D, Gothe CJ, Juhlin L. Carpal tunnel syndrome (CTS) and exposure to vibration, repetitive wrist movements and heavy manual work: A case-referred study. *B J Ind Med* 1989;46:43–7.
6. Fung KK, Chan KY, Lam LY, et al. Study of wrist posture, loading and repetitive motion as risk factors for developing carpal tunnel syndrome. *Hand Surg* 2007;12:13–8.
7. Smith P. *Lister's the hand*. 4th edn. Churchill Livingstone, 2002; 271.
8. Stapleton MJ. Occupation and carpal tunnel syndrome. *Aust N Z J Surg* 2006;76:494–6.
9. Dias JJ, Burke FD, Wildin CJ, Heras-Palou C, Bradley MJ. Carpal tunnel syndrome and work. *J Hand Surg Br* 2004;29:329–33.
10. American Academy of Orthopaedic Surgeons. Clinical practice guideline of the treatment of carpal tunnel syndrome. 2008. Available at www.aaos.org/research/guidelines/CTSTreatmentGuideline.pdf [Accessed August 2009].
11. Andersen JH, Thompson JF, Overgaard E, et al. Computer use and carpal tunnel syndrome: A 1 year follow-up study. *JAMA* 2003;289:2963–9.
12. Stevens J, Witt JC, Smith BE, Weaver AL. The frequency of carpal tunnel syndrome in computer users in a medical facility. *Neurology* 2001;56:1568–70.
13. Falkiner S, Myers S. When exactly can carpal tunnel be considered work related? *Aust N Z J Surg* 2002;72:204–9.
14. Silverstein BA. Occupational factors and carpal tunnel syndrome. *Am J Ind Med* 1987;11:343–58.
15. Hagberg M. Impact of occupations and jobs takes on the prevalence of carpal tunnel syndrome. *Scand J Work Env Health* 1992;18:337–45.
16. Macfarlane GJ. Identification and prevention of work related carpal tunnel syndrome. *Lancet* 2001;357:1146–7.
17. Vender MI, Kasdan ML, Truppa KL. Upper extremity disorders. A literature review to determine work relatedness. *J Hand Surg Am* 1995;20:534–41.