Carpal Tunnel Syndrome – Is it Work-Related?

Background Information:

Anatomy of the Hand and Wrist:

The hand and wrist are made up of bones, ligaments, joints, muscles, nerves and the carpal tunnel, which work together to provide normal hand function. The bones consist of the distal radius, distal ulna, carpals, metacarpals and phalanges. The nerves that supply the hand and wrist include the median nerve, ulnar nerve and the superficial radial nerve. The carpal tunnel is located at the base of the wrist and houses the median nerve and 9 flexor tendons (Hodge, 2004). It is made up of two carpal bones (hook of the hamate and trapezium) and the flexor retinaculum (Dickerson, 2008).

What is CTS?

Carpal tunnel syndrome (CTS) is a condition that occurs when the median nerve is pressed or squeezed at the wrist (Anderson, 2007). It is a common condition that affects between 1 to 2 percent of the population (Anderson, 2007). CTS is most common in people between 30 to 60 years old (Dickerson, 2008). Women are affected up to 5 times more often then men (Hodge, 2004).

What are the symptoms?

Symptoms of CTS typically start gradually and often first appear in one or both hands during the night (Anderson, 2007; Hodge, 2004). Initial symptoms may include frequent burning, itching numbness in the palm of the hand, and tingling in the fingers (thumb, index, middle, and ring fingers). As pain progresses, grip strength decreases, dropping of objects becomes more frequent and performing simple tasks (fastening buttons, typing and grasping small objects) becomes difficult (Hodge, 2004). Some people also report that their fingers feel swollen even though no swelling is apparent. In severe cases, muscular atrophy occurs in the muscles under the thumb.

How is it diagnosed?

There are three main tests to diagnose CTS, which include Tinel's Sign, Phalen's Sign, and Electrodiagnostic Testing.

Tinel's Sign*:* The area over the median nerve at the wrist is tapped. The test is positive for CTS if pain, numbness, tingling, or mild shock is present.

Phalen's Sign or Wrist-Flexion Test: Both hands are placed back to back with palms on the outside. The test is positive for CTS if symptoms develop after one minute of keeping the hands in the abovementioned position.

Electrodiagnostic Testing (gold standard): Measures a reduction in the signal of the median nerve. This can be achieved by nerve conduction or electromyography.

Is CTS a Work Related Issue?

There is controversy as to whether or not carpal tunnel syndrome is work-related. It is often argued that the cause of CTS is unclear and it most likely results from a combination of work-related and non-work related factors (Anderson, 2007). However, some believe that CTS is related to an underlying medical condition, genetic issues, or risk factors such as smoking, alcohol consumption, and obesity. It is also believed that work-related factors, increase the risk of developing CTS, but do not cause it (Hodge, 2004). This has implications with respect to the compensation system because failure to acknowledge this disorder as work-related will result in workers being denied compensation. Alternately, a large proportion of literature supports the belief that CTS is a work-related issue. Research in the following areas supports this claim:

1. The incidence and prevalence of CTS in various populations
2. The contribution of work-related and non-work related factors.
3. Type of work and its relation to CTS risk.
4. Biomechanical mechanisms of increasing pressure in the carpal tunnel.

The following will review the literature to support the notion that CTS is work-related.

The incidence and prevalence of CTS in various populations:

The incidence and prevalence of CTS in working populations supports the claim that CTS is work-related. A study conducted by Roquelaure and associates (2008) looked at the relationship between employment status and CTS incident rate. Study participants included men and women between 20 and 59 years old living in west-central France. Participants were recruited from four electrodiagnostic centers in the region. Inclusion criteria consisted of cases of CTS without prior history in the same wrist, symptoms had to be classified as classic/probable, and two indicators of median nerve damage had to be present. Eligible participants filled out a self-administered questionnaire which asked about medical and surgical history, and employment. The researchers calculated the incidence rate of CTS in relation to employment status. The results showed that the mean incidence rate of CTS was higher in employed than unemployed individuals. In addition, "although the study confirmed the co-existence of medical conditions known to increase the risk of CTS in some patients, it also showed that about 70% of female and 80% of male patients were without them" (Roquelaure, 2008). Anderson (2007) also reported

findings from a study at the Khonkaen University in Thailand, which looked at the prevalence of CTS at a fishnet industry. The outcomes of the study indicated that the prevalence of CTS in the fishnet industry was 14.5%, which is significantly higher then the general population (1 to 2%). The researchers of this study concluded that factory jobs with repetitive hyper flexing and twisting of the wrists are at risk of CTS.

The results of these studies support the notion that CTS is work-related because the incidence and prevalence rates of CTS was higher in working populations and in most cases CTS was present in the absence of medical conditions known to increase the risk.

The contribution of work-related and non-work related factors

Various studies have tried to discern to what extent work-related and non-work related risk factors contribute to CTS. One study evaluated both occupational and non-occupational factors associated with CTS in industrial workers (Maghsoudipour M., Moghimi, S., Dehghaan, F. and Rahimpanah, A., 2008). The non-occupational factors consisted of age, gender, race, BMI, smoking, education and marital status. The occupational factors were bend/twist of the wrist, force, work speed, job rotation and vibration. The results were analyzed using a multivariate logistic regression model whereby an odds ratio was calculated for each factor. An odds ratio determines the strength of an association between data, such that higher values indicate a stronger association. Of the risk factors studied, the top 5 risk factors identified to contribute to CTS were: exertion of force over 1 kg, bending/twisting of the hands/wrist >30 degrees, history of cigarette smoking, rapid movement of the hands, and use of vibrating tools. It is interesting to note that of the top 5 risk factors identified by the researchers, only one was not work related. This strengthens the contention that CTS is a work-related issue.

General predictors of upper extremity symptoms have also been investigated. A study by Gardner (2008) looked at workers employed for 6 months in a new job. The purpose of the study was to identify personal and work-related predictors of upper-extremity symptoms. The findings indicated that predictors of upper extremity symptoms were wrist bending, forceful gripping, age, race, gender and a baseline history of upper extremity symptoms. Again, this study links work-related factors to upper extremity symptoms; however these were not directly related to CTS. It should be noted that this study did not look at the strength of association between risk factors, but merely identified them.

Nature of work and CTS risk

A systematic literature review was completed for 38 articles to examine the evidence linking CTS with work (Palmer, 2007). The researchers found evidence that regular and prolonged use of hand-held vibratory tools increases the risk of CTS >2 fold. They also

concluded that even higher risks are associated with prolonged and highly repetitive flexion and extension of the wrist, especially when coupled with a strong grip (Palmer, 2007). Similarly, Fung and associates (2007) identified that frequent flexion/extension, and sustained force of the wrist increases the risk of developing CTS. From the findings of these two researchers we can conclude that jobs requiring repetitive and/or forceful hand/wrist tasks increase the risk of developing CTS.

A number of sources have documented that CTS is a common injury in assembly line work (manufacturing, sewing, finishing, cleaning, meat/poultry/fish packaging) (Anderson, 2007; Hodge, 2004). This is not surprising since this type of work typically requires repetitive flexion/extension of the wrist, forceful exertions, and use of vibrating tools, which are known risk factors of CTS. Similarly, the percentage of CTS cases attributed to certain types of work has also been determined. Roquelaure (2008) concluded that CTS cases could be attributable to work for about 75% of male blue-collar workers, 67% of female blue-collar workers and more than 50% of female lower grade services, sales, and clerical white-collar workers.

Less evident is the impact of computer work on CTS. A review of 38 articles from the start of the electronic record to January 2005 indicated that, “the balance of evidence on keyboard and computer work did not indicate an important association with CTS” (Palmer, 2007). Similarly, a study conducted by the Mayo Clinic looked at CTS in frequent computer users and concluded that 3.5% of computer users had CTS which was similar to the general population (Stevens, 2001). It should be noted that the frequency of CTS in the general population was not reported in this study and therefore it is difficult to compare the results of this study to the general population. An article by Anderson, 2007 indicated that CTS affects 1 to 2% of the general population. Therefore, the percentage of computers users with CTS (3.5%) may actually be greater then that of the general population (1 to 2%) as reported by Anderson, 2007.

More recently, a study was conducted to determine whether upper extremity musculoskeletal disorders are more prevalent in intense computer users (Aydeniz, A. and Gursoy, S., 2008). Intense computer use was defined as working on a computer more than 6 hours per day for at least 2 years. A control group consisting of 65 age and sex matched individuals who worked no more than 2 hours on a computer per day were also studied. The results indicated that all soft tissue disorders were more prevalent in the study group, however only a significant association was found between CTS and cumulative time of computer use (Aydeniz et al., 2008). Similarly, Jensen (2003) found that the duration of computer use was not associated with neck symptoms but was associated with hand/wrist symptoms.

Biomechanical mechanisms of increasing pressure in the carpal tunnel

The National Institute of Neurological Disorders and Stroke has reported that insufficient data exists to prove that repetitive and forceful hand and wrist movements can cause carpal

tunnel syndrome (Hodge, 2004). A large number of research studies that have found that repetitive and/or forceful hand/wrist tasks increase the risk of developing CTS. In addition, it is known that anything that causes a rise in pressure in the carpal tunnel can cause CTS (Dickerson, 2008). Evidence from the literature will be presented to prove that certain wrist movements can increase the pressure in the carpal tunnel and therefore can cause CTS.

Carpal tunnel pressure is strongly influenced by forearm, wrist and finger postures (Palmer, 2007). One study flexed and extended the radiocarpal joint of a rabbit (80 cycles/min; duration of 10 hours). The result was swelling in the tunnel and slowed median nerve conduction over a period of days (Palmer, 2007). Although this is an extreme scenario, this study confirms that it is possible for wrist flexion and extension to result in swelling in the carpal tunnel. Another study looked at the change in intracarpal canal pressure (ICCP) when the wrist is in different positions (Werner et al., 1997). The study found that ICCP is lowest when the wrist is in a neutral position and highest when the wrist is in extension or flexion (Werner et al., 1997). Forearm pronation and supination were also found to increase ICCP. The conclusions of this study were that maintaining a neutral wrist posture will minimize pressure within the carpal tunnel and reduce the risk of developing CTS (Werner et al., 1997). The findings in these studies confirm that repetitive and forceful hand/wrist movements can cause swelling and increase the pressure in the carpal tunnel, which is directly related to the injury mechanism.

Conclusion

The literature supports the belief that CTS is a work-related issue. Specifically, work requiring repetitive and forceful hand/wrist motions are high risk for CTS. Typically these hand/wrist motions are seen in assembly line work (manufacturing, sewing, finishing, cleaning, meat/poultry/fish packaging) and intense computer work. The incidence and prevalence of CTS is higher in working populations than in the general population. The top 5 risk factors identified to contribute to CTS are exertion of force over 1 kg, bending/twisting of the hands/wrist >30 degrees, history of cigarette smoking, rapid movement of the hands, and use of vibrating tools. Repetitive and forceful hand/wrist movements have been reported to cause swelling and increase the pressure in the carpal tunnel, which is directly related to the injury mechanism of CTS.

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