CHIROPRACTIC MANAGEMENT OF CARPAL TUNNEL SYNDROME

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INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the leading causes of work related injuries in industries for a number of reasons. First, technological changes have increased the pace in which the worker must perform (1). Production rates have increased dramatically with high tech approaches and as a result, the requirement of the worker to keep up with the escalation in rate has resulted in a greater number of overuse syndromes or, cumulative trauma disorders. Second, the work force is aging as more people are working later in life (2). For example, Kaplan found that people over 50 years of age have a greater risk at failing conservative medical treatment (3). A 3 to 1 female-to-male ratio has been reported with peak incidence at 45 to 54 years of age for women (4).

Chiropractic has been well studied in the management of neuromusculoskeletal disorders involving the axial skeleton, and recently, chiropractic has been recommended as a priority health care provider in acute low back pain management by the AHCPR, Brittish Medical Guidelines, and the Canadian guidelines (5-7). However, less has been published regarding the management of peripheral joint conditions such as CTS. This paper will review the case presentation of the CTS patient, the clinical findings, and treatment protocols which have been proposed. A review the current literature regarding the chiropractic management of CTS will also be included.

DEFINITION

CTS may be defined as the neurological sequella of compression of the median nerve as it passes through the carpal tunnel of the wrist. There are many causes of CTS but the common denominator is the contents of the tunnel swell or, some space occupying entity exists in the tunnel causing a compression neuropathy of the median nerve giving rise to the peripheral nerve dysfunction. One may categorize the etiology of CTS broadly into two:

1. Mechanical – such as repetitive motion and overuse
2. Metabolic – secondary to diabetes, hypothyroid, oral contraception, total hysterectomy, obesity, various arthridites, ganglion cysts and others.

CASE PRESENTATION

The individual suffering from CTS will typically present with some degree of paresthesia or numbness in the radial side of hand affecting to varying degrees, the thumb through radial half of digit 4. Sensory loss to the thenar aspect of the hand is usually spared due to the palmar branch of the median nerve exiting 3 cm proximal to the transverse carpal ligament. Sensory changes usually occur first but examination findings early on often yield negative findings. The third digit is usually affected first in the distal aspect in the early onset of CTS (8, 9). Often, symptoms increase nocturnally and can interrupt sleep and demand shaking the hand or flicking of the fingers before returning to sleep. Symptoms can also be provoked by static postures of the hand and/or upper extremity such as gripping a steering wheel while driving.

ASSESSING CARPAL TUNNEL SYNDROME

HISTORY

An accurate history is perhaps the most important aspect in the assessment process of CTS. Several tools have been found as very useful in the assessment of CTS. More specifically, Katz published that the hand pain drawing alone carried a + predictive value of .59 and this increases to .71 when combined with a + Tinel's test (10). He also reported age was important as only 9% of the subjects found + for CTS were < 40 years of age. The history is also important for differentiating an occupational from a non-occupational CTS patient (11).

Since many causes of CTS include other cumulative trauma disorders (CTD's), it is important to gather a detailed history regarding the patient's occupation. In general, without a thorough history, one can easily miss a potentially important clinical entity that may be the reason why a stubborn CTS case doesn't respond to conservative treatment and could lead to unnecessary prolonged conservative care and/or to an unnecessary surgical release.

PHYSICAL EXAMINATION

The physical examination of CTS can include both low-tech and high-tech approaches. Regarding low-tech

approaches, Katz published that a good quality neurological examination is a difficult match for most high-tech tests for assessing CTS (10). More specifically, an 84% sensitivity and 72% specificity was reported regarding a high quality neurological PE. In descending order, Szabo, Gellman, and Koris have published the following sensitivities and specificities of the following tests (12, 13, 14):

SENSITIVITY SPECIFICITY

1. Semmes-Weinstine monofilaments 91% (86)
2. Phalen's test 70% (80)
3. Tinel's tap test 61% (94)
4. Two point discrimination 33% (100)

Other provocative tests regarding carpal tunnel syndrome include the median nerve compression test (15). In this 1985 study, Paley describes two phases of the test. The first is the time relative to the onset of paresthesia, while the second phase is the recovery time after the compression is released. This test is performed by placing thumb pressure over the carpal tunnel, monitoring the second hand of a watch, and documenting the onset of paresthesia as well as the recovery time. In this paper, Paley states that it normally takes 15 to 20 minutes of compression in a normal wrist to produce the onset of paresthesia compared to 15 to 120 seconds in carpal tunnel syndrome patients.

The median nerve tether test is another provocative test that has been published by LaBan, et al., 1986 (16). In general, this evaluates for stenosing tenosynovitis of the wrist and finger flexor tendons in the flexor compartment of the antebrachium which travel through the carpal tunnel. This test is performed by dorsiflexion of the wrist and digits 2 through 4 to a point of firm end feel. It is then compared with the less, or uninvolved side. Positive findings includes pain in the proximal volar antebrachium and in general, tightness, with a taut end-feel and reduction of motion when compared to the less or uninvolved side. When positive, it is indicative of chronic carpal tunnel syndrome.

The wrist dorsiflexion test which is sometimes referred to as the reverse Phalen's test has been described as a provocative sign of CTS when reproduction of symptoms occur in less than 60 seconds. This test is less sensitive than Phalen's test, which makes sense, since the pressure within the carpal tunnel is greater in palmar flexion than in dorsiflexion.

The flick test was described by Krendel in 1986 (17). This test is simply the observation of a patient shaking their hand and flicking their fingers due to the onset of paresthesia. It is the attempt of the patient to return the normal feeling into the digits and is often described as being employed during the night time if they are awakened by paresthesia.

In general, it can be said that the greater number of positive orthopedic provocative tests, the better established is the diagnosis of carpal tunnel syndrome.

With regard to the neurological examination of the motor division, it is imperative that the chiropractic physician evaluate the integrity of the cervical nerve roots as they exit the IVF to rule out a proximal compression which may give rise to the "Double Crush Syndrome". Double or multiple crush syndrome is a phenomenon that can take place when mild compression is exerted on the nerve in more than one location. A mild degree of CTS may not be symptomatic until a second compression occurs at the nerve root or peripheral nerve, thus resulting in the onset of symptoms. This "summation" affect is a published neurological phenomenon first described by Upton and McComas in the Lancet in 1973 (18). Entrapment neuropathy in the periphery as it affects the median nerve can occur at multiple cites and therefore, assessment of the anatomy proximal to the wrist is important. More specifically, the median nerve can get trapped by the ligament of Struthers, if a supracondylar process is present at the distal third of the humerus. A more common site of entrapment proximal to the carpal tunnel can occur at the pronator teres muscle in the proximal volar antebrachium. This author has found very frequently, entrapment at the pronator teres muscle in addition to the carpal tunnel. In fact, very often, the onset of paresthesia with compression testing at the pronator teres muscle occurs more quickly than compression testing at the carpal tunnel.

With regard to motor evaluation of the median nerve, grip and pinch strength have been published as being reliable approaches. When testing grip strength, the Jamar hand dynamometer has been the published method of choice due to the established normative databases. Though there are several methods of testing grip strength, the most common procedure utilized is performed by repeating the procedure at three different intervals during the examination and less than 20% variation in the readings is expected. If greater than 20% variation occurs, less than optimal effort is being applied or, pain induced weakness is present. The 3 readings are averaged and recorded. If the patient possesses bilateral carpal tunnel syndrome, Swanson et al., have published several normative data charts which are age, gender, occupation and hand dominant specific which can be referred to for comparison (19). A table also is available for lateral pinch strength as noted by occupation, gender and hand dominance.

The sensory portion of the neurological physical examination is important as typically, sensory changes occur prior to motor changes. When testing the sensory system, Semmes-Weinstine monofilaments appear to be the most sensitive and specific when compared to other low tech, non-electronic instrumental types of testing approaches as well as when compared to the high-tech instrumentation of neurometry, vibrometry and various techniques utilizing electromyography and nerve conduction velocity. Koris reported further augmentation when testing is performed in the Phalen's or wrist palmar flexed position (14). The Semmes-Weinstine monofilaments vary according to diameter size and hence, stiffness. The test is performed by applying progressively smaller gauged plastic filaments perpendicular to the skin until the filament bends. The patient with eyes closed is asked to describe whether or not a sensation is perceived. The light monofilaments (1.65 to 3.84) are applied to the skin three times whereas the heavier monofilaments (4.08 to 6.65) are applied in one motion (12). The last gauge detected is then documented and this is performed bilaterally for comparison.

A second method of assessing sensory change associated with CTS is 2-point discrimination. Gellman reported two-point discrimination to be very specific at 100% but had poor sensitivity of 33% (13). The International Federation of Societies for Surgery of the Hand have defined the various levels of 2 point discrimination perception as follows (20): 1. 0-6mm is considered normal. 2. 7-15mm is considered partial loss. 3. 15mm or greater constitutes complete loss. It is important to recognize that this is in reference to application of 2-point discrimination over the surface of the hand and not over the arm or trunk, as the homuncular pattern on the sensory cortex has greater neuronal representation from the head, hands and feet as described by Guyton (21) and others.

HIGH-TECH TESTING

The next level of testing the sensory system include various high-tech tests. Vibrometry is a non-invasive, painless and relatively easy to use devise which can detect early peripheral sensory nerve dysfunction prior to nerve damage (22). Standards for calibration have been established by Jetzer and Conrad (23). Vibrometry has proved valuable for monitoring the effects of treatment and in addition, can also be used as a screen to detect early CTS in the work place.

A neurometer which measures current perception threshold (CPT) values has been compared to nerve conduction testing (NCT). Peripheral neuropathy was detected in 92% of the patients using CPT verses 79% using NCT ($p<0.001$). further, cpt's consistent with CTS with combined median and ulnar nerve involvement were noted in 31% compared to 11% of the hands using nct. the benefits of the neurometer or cpt, when compared to nct include:

1) a unique ability to quantify hyperesthesia (as well as hypesthesia);
2) it is extremely sensitive (24);
3) provides quantitative information of both small and large peripheral nerve fibers (25);
4) it is a quick (10 min.) procedure, portable (plug or battery driven) and painless. therefore, it is ideal for utilizing as a screen for detecting peripheral neuropathy associated with diabetes (26), during hemodialysis (25/5), and in occupational settings for CTS (27). Both CPTs and vibration thresholds were found to be more sensitive than ncv.

In spite of the seemingly more sensitive diagnostic tests of neurometry and vibrometry, EMG/CV are still considered the "gold standard" of the high tech neurological tests for CTS and the chiropractic physician is encouraged to utilize an emg/cv when a point of plateau short of resolve with residual disabilities exist and surgical referral is being considered.

Winn and Habes reported that mri and ct scan are helpful in assessing CTS (28). X-ray has also been used and is helpful in detecting radioopaque lesions in the CT such as a calcified tendonitis or a spur. moliter published in 1988 the use of ultrasound as a diagnostic test for detecting CTS (29). It is this author's opinion that the practicality, utility, cost, as well as the sensitivity of these tests, especially mri/t, do not warrant their use, especially when there are many accurate low-tech, low-cost methods of assessing CTS as previously described.

PROGNOSIS OF CONSERVATIVE TREATMENT OF CTS

Kaplan in 1990, published an article introducing a prognosis scale regarding the non-surgical medical treatment of CTS (3). More specifically, a score is calculated where one point is assigned to each of 5 factors which if present, are added together. in general, the higher the score, the poorer the prognosis. the study revealed reliability in predicting the prognosis or failure rate of non-surgical medical management of CTS. the 5 factors that kaplan describes are as follows:

1. Greater than 50 years of age.
2. Greater than 10 months of symptom duration prior to presentation.
3. constant paresthesia.
4. Presence of stenosing tenosynovitis of the flexor

tendons (trigger finger).

5. Phalen's test positive in less than 30 seconds. Kaplan revealed that scores of 3 or more on the 0 to 5 scale constituted a 93 to 100% chance for failure. when scores ranged between 0 and 2, a 33 to 83% chance of failure was reported.

This author was involved in a study where 86 hands of a sample of 52 patients with CTS were treated (30). Of those that scored 3 or more on Kaplan's 0 to 5 scale, 32% failed (compared to kaplan's 93-100%) and those with 0-2/ scores, 13% failed (verses Kaplan's 33-83%). This study suggests that chiropractic conservative treatment may have a greater therapeutic benefit compared to the medical conservative approaches described by Kaplan. it is important to note that many of the conservative medical treatments utilized by Kaplan are also standard conservative chiropractic therapies for CTS such as cock-up splinting, nsaid's, and ergonomic modifications of the work site. the unique differences between the conservative treatment of CTS by chiropractors and medical doctors appears to be the use of manipulative and soft tissue therapies by chiropractors and the use of corticosteroids by the medical physicians. the scale introduced by Kaplan can be used as a prognostic tool for guiding conservative management of CTS but caution is recommended when applying kaplan's statistics which represents the conservative medical treatment, not chiropractic.

Because chiropractors deliver a conservative (non-surgical) treatment approach, it is essential to utilize the concept of "triage" in order to avoid a possible delay of appropriate surgical decompression. dawson describes findings of thenar wasting, skin atrophy and dexterity loss during examination suggests poor prognosis regardless of the therapeutic approach (9). It is also important to understand that the length of time the median nerve is compressed is less important than the amount of compression as irreversible nerve damage can occur in a very short time duration in an acute case of CTS such as when bleeding into the ct occurs with a wrist fracture. Dawson describes cases of chronic long-standing CTS may remain emg/cv negative when tested years after symptom onset in contrast to the case of acute CTS secondary to fracture (9).

TREATMENT OF CARPAL TUNNEL SYNDROME

MANIPULATION

Treatment must address the specific needs of the patient regarding the three phases of healing of an injury: the acute, subacute, and chronic stages. Also, active care or, patient participation in a home-based stretch and strengthening exercise program can address many of the goals of the three healing phases. It has been this author's experience that treatment should be administered along the entire course of the nerve or, from the cervical spine to the hand. this insures multiple or double crush aspects of the condition are attended. The specific type cervical spine manipulation utilized by this author addresses the hypomobile vertebral motor unit(s), using a high velocity, short lever arm manipulation, which is usually accompanied by the release of gas or, joint cavitation, producing an audible click. post-manipulation evaluation usually reveals an immediate increase in active rotation range of motion (ROM). If less than optimum results are achieved, myofascial release techniques such as pnf stretching, reciprocal inhibition, muscle energy, or any other type of soft tissue release technique may be required.

The next area to consider when treating the CTS patient is the shoulder region. shoulder mobilization can include progressive passive shoulder abduction and Figure 8 motions with the objective of releasing soft tissue fixation and capsular adhesions by applying simultaneously, moderate to deep manual pressure in the infraclavicular region with the patient seated. Patient tolerance must be monitored and respected in order to avoid further impingement in a grade 2 sprain or strain with accompanying bursitis.

Manipulative procedures performed at the elbow can be directed to the radial head usually in an anterior or posterior direction. again, care must be exercised in order to avoid elbow hyperextension and resulting pain. radial head manipulation is often accompanied by an audible release. it has been this authors experience that soft tissue release techniques in the volar antebrachium, especially over the pronator teres muscle may greatly facilitate the release of the tight myofascial soft tissue component.

Specific manipulation of the wrist utilized by this author, is administered after identifying the areas of greatest fixation. many variations of manual therapies exist. one approach utilizes a double thumb contact over the fixated or hypomobile carpal joint. one to several high velocity, short lever arm thrusts with concomitant traction on the wrist are applied to the hypomobile joint(s) on the dorsum and/r volar aspect of the wrist, dependent on fixation pattern, and audible cavitation or "releases" are usually obtained. a distraction mobilization technique is also utilized, separating the radio-carpal and carpal-carpal joints utilizing a "hand-shake" contact while stabilizing the distal antebrachium with the indifferent hand.

Another manipulative technique includes the intertwining of the doctor's fingers on the dorsum of the patient's wrist with the line of drive directed through the calcaneal aspect of both hands, in attempt to approximate the ulna and radius on the volar surface. the objective of this technique is to attempt to increase the depth of the ct canal by approximating the ulna and radius. mobilization can be applied to the wrist and/r the metacarpophalangeal joints of the hand with the use of an a to p shearing technique.

SOFT TISSUE THERAPY

This treatment may include the use of a vapo-coolant such as fluori-methane releasing myofascial adhesions in both the flexor and extensor antebrachial compartments in the proximal and mid portion of the antebrachium. This may also be utilized over other areas of trigger points (myofascitis) in the upper extremities and cervical region. Travell (31) describes using a 30° angle applying the vapo-coolant in parallel lines in the direction of the muscle fibers first over the tightened muscle fibers followed by the rest of the muscle. The speed of application should be approximately 4 inches / second, approximately 18 inches from the skin. Proprioceptive neuromuscular facilitation (PNF) can be applied to the flexor and extensor compartments of the antebrachium. PNF techniques may include contract hold, eccentric and /or concentric muscle stretching, and others.

ORTHOTICS

The use of supportive orthotics are popular in the treatment of CTS. supportive therapy may include the use of a wrist cock-up orthosis and/r an elastic wrap. Past literature supports the use of a cock-up splint to be utilized while working, especially if a repetitive motion environment is present. Today however, there appears to be agreement that the cock-up splint should not be used at work due to the restriction it places on wrist motion and the tendency to "fight" against the splint often resulting in bruising. nocturnal use, and the use of the splint while driving have remained popular.

ERGONOMIC MODIFICATIONS

The key to solving the stubborn case of CTS may lie in modifying a work station, the tool design, or the manner in which the patient approaches their job. the latter is especially true if the patient is paid by the rate of production or, by the volume of product produced (piece rate). A difference in wage may reduce by as much as one half when comparing a slow verses a high rate of production. until a light duty restriction and/r removing the worker from the rated job site is performed, it may be impossible to reduce the tendonitis within the carpal tunnel. Some other occupational risk factors to consider include the following (32):

1. cold, ambient temperatures such as working in coolers or freezers.
2. vibration.
3. slippery surface of a tool.
4. a handle which is too small or too large to adequately grip.
5. high forces required, especially if in an awkward position.
6. fast, repetitive work, especially from a pronated position.
7. an abrupt, firm end during the use of a power tool, such as when securing a bolt using an air wrench with a poor clutch. When these risk factors exist, the probability of carpal tunnel syndrome increases dramatically. The topic of ergonomics is very important and deserves an entire article to adequately cover this treatment recommendation.

VITAMIN B6 - PYRIDOXINE

When this was previously investigated, this author categorized the literature review into two groups (30). The first was made up of articles which favored the use of b6 and the second were those which did not. a total of 23 referenced articles were reviewed, 11 pro and 12 con regarding the use of b6 in the treatment of CTS. In summary, I could not conclude that b6 was significantly beneficial in managing CTS. In my personal experience, I have not observed significant results by implementing b6 alone nor when applied in conjunction with conservative chiropractic treatment in resistive CTS cases. More study is needed in determining the benefits of b6 in the treatment of CTS comparing it to a placebo, manual therapy, modality therapy, pharmaceutical therapy, splint therapy, and the like before a firm statement can be made regarding its effectiveness in this author's opinion.

REVIEW OF LITERATURE

Review of chiropractic literature through 1992 can be found in this author's book chapter published in "Chiropractic Family Practice" ed. by Joseph Sweere, 1993 by Aspen Publishing (30). Literature since 1992 has included a follow-up study by Bonebrake, where the initial 1990 article reviewed several diagnostic methods of assessing CTS followed by treatment of a group of patients with CTS utilizing the diagnostic tests found reliable and sensitive for assessing outcomes (33). The 1993 article is a 6 month follow-up on the patient sample reported in the first publication (34). Results indicate

statistical significance regarding lasting benefit from the previously rendered chiropractic treatment.

Ferezy and Norlin published a case report involving a 57-year-old female who responded favorably to chiropractic management in spite of significantly positive emg and sensory ncv studies (35).

Leahy describes a type of myofascial release technique which successfully manages CTS (36-39). Sucher also describes a myofascial release type of treatment which includes a home stretch form of exercise (40-41). Sucher also introduces a palpation classification scheme and compares it to EMG reporting the ability to discriminate the severity of CTS by applying the palpation method (42).

Due to time restraints, it is beyond the scope of this lecture series to properly review these references. I recommend the reader obtain the articles listed in the "suggested reading/references" section following the outline for further review.

CONCLUSION

As a greater percentage of patients choose chiropractic as their first portal of entry, the dc must be prepared to properly assess, document, and deliver treatment. in addition, the concept of "triage" must be employed by providers of all disciplines with regards to referring patients to the best choice of health care providers. recently, the literature has strongly supported early intervention of manipulation for acute low back pain as a treatment of choice, but little has been published regarding chiropractic management verses medical or other health care approaches in the treatment of carpal tunnel syndrome. Though larger studies with blinded subject and control groups are needed, it appears that there is an advantage to the treatment of the articular and soft tissues involved in CTS prior to surgical referral over the conservative measures popular in the medical field.

The most important concepts for the chiropractor to consider when managing the carpal tunnel case in this author's experience, are as follows:

1. to evaluate all non-mechanical or, metabolic causes or contributors of CTS.
2. to properly recognize the "red flag" of an acute cause of CTS, such as bleeding secondary to fracture.
3. to render treatment with distinct goals, especially emphasizing an early return to work, in order to avoid chronicity and promotion of disability.
4. to recognize, before beginning treatment, the difficult case and prompt consideration of a multidisciplinary treatment setting.
5. to include a work station assessment to help avoid repeat occurrences and/r treatment failure.
6. to include treatment of the entire neurological "limb" (from cervical spine to hand), especially when double or multiple crush is present.
7. to differentially diagnose all three peripheral nerves as often, ulnar nerve entrapment at the elbow's cubital tunnel and less often, the radial nerve at the radial tunnel are involved.
8. to recognize the risk factors, educate the patient, and utilize active/ome care rehabilitation approaches.

As chiropractic moves into a more prominent role in the health care system, the more one can expect to see extremity complaints coming into the chiropractic office. Proper education and recognition of the formula of "force plus repetition plus poor posture plus no rest="cumulative" trauma disorders", will help guide the health care provider in addressing proper treatment goals.

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