

# Effective Treatment of Bilateral Carpal Tunnel Symptoms Using Cervicothoracic Thrust Manipulations, Neural Glides, and Periscapular Strengthening: A Case Report

Francois Prizinski, DPT, OCS<sup>1</sup>  
Joseph Brence, DPT<sup>1</sup>

<sup>1</sup>Practitioners, Physiotherapy Associates, Pittsburgh, PA & Regular Contributors to [www.physiotherapyinfo.com](http://www.physiotherapyinfo.com)

## ABSTRACT

To date, there has been little research to look at the effects of treating the cervicothoracic spine for decreasing symptoms distally to the carpal tunnel. This case report documents the treatment of a 39-year-old female who was referred to our clinic with bilateral carpal tunnel symptoms, forward head posture, and decreased cervical range of motion (ROM). It was believed following the physical examination that mobility deficits of the upper thoracic spine were contributing to distal symptoms at the wrist. Treatment was directed at increasing mobility in the cervicothoracic junction (CTJ) and upper thoracic spine, along with decreasing neural tension that resulted in a decrease of this patient's symptoms at the carpal tunnel. Further research needs to be conducted to identify if a regional interdependent relationship exists between these areas.

**Key Words:** carpal tunnel, manipulation, thrust, neural glides

## BACKGROUND

Carpal tunnel syndrome (CTS) is a commonly seen diagnosis within the realms of outpatient physical therapy. Approximately 1% to 3% of individuals are diagnosed with CTS with a higher documented prevalence in women than men.<sup>1,2</sup> Carpal tunnel syndrome occurs from a compression of the median nerve as it passes from the forearm, through the carpal tunnel, and into the wrist. Patients often present with complaints of paresthesia, pain, numbness, and tingling into the first three digits, and sleep disturbances.<sup>2,3</sup> Currently, there is varying evidence for the effective nonoperative treatments for CTS with limited research suggesting the use of nonsteroidal anti-inflammatory medications, corticosteroid injections, neutral wrist splinting, nerve/tendon gliding exercises, ultrasound, and laser.<sup>2-5</sup> Alternative methodologies such as yoga have been said to be effective with some lower level evidence to support its use.<sup>6</sup>

De-La-Llave-Rincon et al recently published a case control study that examined the relationship between CTS and a forward head posture (FHP)/decreased cervical range of motion (ROM).<sup>7</sup> This study demonstrated a proximal-distal relationship may exist between the wrist and cervical spine and suggests addressing mobility deficits of cervical ROM when treating CTS. Although there is supported evidence for thrust manipulations to improve cervical ROM<sup>8-11</sup> and reduce symptoms as distal as the lateral epicondyle,<sup>12</sup> little evidence exists for the use of these in the management of signs and symptoms typically associated with carpal tunnel syndrome.

Double crush and T4 syndromes must also be considered when differentially diagnosing and treating pain that is occurring in both the cervicothoracic spine and distal structures such as the carpal tunnel.<sup>13</sup> Double crush syndrome is defined as a proximal lesion along an axon that predisposes it to injury at a more distal site along its course.<sup>14</sup> In 1973, Upton and Mccomas<sup>15</sup> described this syndrome in patients who presented with carpal tunnel syndrome or ulnar nerve lesions at the elbow with associated neural lesions in the neck. They believed the result of this was due to a restraint of axoplasmic flow in nerve fibers.<sup>15</sup> A case series study was also performed involving 1,000 cases of carpal tunnel syndrome and the authors determined that there was a statistically significant correlation between bilateral features and cervical arthritis and that this may be a demonstration of a double crush syndrome.<sup>16</sup> Similar to double crush syndrome, T4 syndrome can cause an individual to experience proximal and distal disturbances. This disorder is predominately found in women between the ages of 30 to 50 who present objectively with FHP/decreased cervical ROM, reversed thoracic kyphosis, local tenderness, positive bilateral ULTT, and hypomobility with reproduction of symptoms upon posterior to anterior springing of the thoracic vertebrae. Although its termed

T4 syndrome, it can involve any segment from T2-7 with T4 most often involved given the relationship and proximity of the sympathetic trunks lying on or just lateral to the costovertebral joints.<sup>9,17,18</sup>

This case report is to present the effective, short-term treatment of an individual who presented to our facility with localized symptoms at the base of the neck, FHP, and sensation disturbances, described as pins and needles, over bilateral carpal tunnels. Treatment consisted of thrust manipulations of the cervicothoracic and thoracic spine, neural mobilizations of the median nerve, periscapular strengthening, and the use of neutral wrist splints nocturnally. Her case was unique because she demonstrated an immediate decrease in symptoms to the carpal tunnel following thrust manipulation techniques to the cervicothoracic and thoracic spine. Recent literature has described "regional interdependence," which refers to a concept that seemingly unrelated impairments in one anatomical region may be contributing to, or be associated with, the patient's chief complaint.<sup>19-22</sup>

## PATIENT CHARACTERISTICS

This case study involves a 39-year-old female referred to physical therapy with a medical diagnosis of bilateral carpal tunnel syndrome, cervicgia, and skin sensation disturbances. She signed an informed consent form to document her case and treatment.

## Subjective Examination

Prior to the initial examination, the patient filled out a pain diagram and visual pain rating scale. On this scale, she indicated her symptoms were occurring at the cervicothoracic junction (CTJ), described subjectively as deep ache, as well as the palmar aspect of bilateral wrists and described subjectively as pins and needles. She rated her pain as 1/10 currently, 3/10 at worst, and 1/10 at best over the last 24 hours on a numerical rating scale that has been pre-

viously shown to be valid and reliable.<sup>23</sup> She also completed a neck disability index (NDI) that indicated a 20% disability with most noticeable deficits involving activities such as sleeping and reading. The NDI has fair to moderate test-retest reliability in patients who present with mechanical neck pain<sup>24</sup> and moderately reliable for patients with mechanical neck pain with upper extremity referred symptoms.<sup>25</sup>

The patient reported that she had noticed an insidious onset of stiffness into the base of her neck with bilateral palmar wrist sensation changes approximately 3 weeks prior to seeking physical therapy care. She described these symptoms as occurring in the morning, decreasing into early afternoon, and returning later in the day. She reported she was a “side sleeper” and would often assume a fetal position in bed (which worsened symptoms to wrists by morning), demonstrating a protracted scapula, flexed elbow and wrist position. She worked part-time as a homecare occupational therapist and had been working more than usual on chart reviews and also using the computer, which would make her pins and needles worse at the wrists and increase pain at the base of her neck. This pain led to a decrease in her ability to participate in activities such as reading for enjoyment in a pain-free manner.

The patient also reported a history of migraines but stated she had not experienced any within the last year. She reported taking Celexa, an antidepressant, and a multivitamin. She was given bilateral neutral wrist splints by her primary care physician that she had been wearing to bed for a couple of days prior to coming to therapy, but were unsuccessful in controlling symptoms.

### Objective Examination

The examination began with postural visual assessment. The patient had a forward head and rounded shoulders posture in an unsupported seated position with decreased lumbar lordosis. Cervical active range of motion (AROM) measurements were taken in a seated position with the patient’s lumbar posture corrected via tactile cues. An inclinometer was used to assess flexion, extension, and side bending; a standard goniometer was used for rotation. The measurements were as follows: flexion 45°, extension 45°, bilateral sidebending 25°, left rotation 70°, and right rotation 60°. Cervical AROM in flexion and extension repro-

duced the patient’s chief complaint of pain at the CTJ. Wrist AROM measurements were assessed with a standard goniometer and were measured as: wrist extension (with elbow extended to 0°) Right 60° Left 65°. She had decreased flexibility noted in bilateral upper trapezius and wrist flexor muscles and weakness of bilateral middle/lower trapezius 4-/5 and serratus anterior 4-/5 as determined by standard manual muscle test positions. Deep neck flexor endurance testing was assessed in supine and demonstrated < 10 sec of hold before losing position from fatigue.<sup>26</sup> Bilateral grip strength was measured at 60 lbs of force using a standard grip dynamometer set on the 2nd position. Palpation testing was positive for latent myofascial trigger points at bilateral upper trapezius muscles with mild radiating features into the cranium.<sup>27</sup>

Because active cervical flexion and extension reproduced symptoms at the CTJ, passive accessory intervertebral movements (PAIVMs) were performed from T1 to T7 with the patient in a prone position. The patient had positive PAIVMs for reproduction of chief complaint over the right unilateral segments of T2-3. Symptoms were also reproduced with PAIVMs over T1 through T4 with P/A glides. Since reproduction of the patient’s chief complaint was confirmed with cervical active flexion/extension and PAIVMs over T1 through T4, manual treatment interventions were justified for these areas.

A neural tension screen was then performed that revealed positive upper limb tension (ULTT) for the median nerve and reproduction of her chief complaints of pins and needling at the wrists. Right elbow extension range was limited to -70° and the left elbow at -75° for reproduction of symptoms. A positive ULTT was determined by the appropriate test position described in the literature and reproduction of the chief complaint by contralateral sidebending of the cervical spine.<sup>28</sup>

A neurological examination was performed to rule out any upper motor neuron pathology or sensory disturbances to warrant referral for further diagnostics or contraindications for thrust manipulations. Deep tendon reflexes of C5/6/7 and L4/S1 were measured at 2+ with a standard reflex hammer. She also demonstrated a negative Hoffmann’s test and negative clonus with brisk ankle dorsiflexion (DF) from a seated position. A positive Hoffmann’s sign has been shown to indicate an isolated upper

motor neuron lesion of the cervical spine and when combined with increased deep tendon reflexes, has high diagnostic value for cervical myelopathy.<sup>29,30</sup> She did not present with dermatomal patterns or sensory loss with cutaneous nerve distributions and had negative Phalen’s and Tinel’s signs. Abductor pollicis brevis manual muscle testing for recurrent median nerve motor innervation was 5/5 and painless bilateral. A systematic review to determine the best diagnostic criteria for CTS concluded that hypalgesia in the median nerve dermatome, hand diagram results and weak thumb abductor strength had positive likelihood ratios for individuals found to have CTS electrodiagnostically. Phalen and Tinel signs have been found to be of little diagnostic value for CTS.<sup>31</sup>

### Clinical Impression

Following the examination, the clinician believed the patient presented with an indefinite clinical presentation of CTS with double crush and T4 syndrome features.

### Interventions

Following the initial evaluation, the treating therapist educated the patient in modifying her sleeping position from side sleeping to “pseudo side sleeping.” This position was defined as lying on a 45° angle to decrease the amount of scapular protraction. She was also directed to continue nighttime use of the wrist splints to limit curling wrists/shoulders into the fetal position. The clinician then applied moist heat to the cervical spine with TENs on bilateral upper trapezius muscles. This was done to decrease overactive myofascial trigger points in the upper trapezius that may have restricted her cervical ROM<sup>32</sup> and/or has contributed to the upper limb tension bilaterally.<sup>33</sup>

Following the initial education and modalities, the patient was educated in and consented to using manual therapy techniques to address mobility deficits of the CTJ and thoracic spine. Thrust manipulation techniques were applied to the CTJ and midthoracic spine with the patient seated. The patient was then instructed to perform the following movement activities:

**Wing arm breathing:** Patient seated with an erect/upright posture and palms supinated. She then performed active glenohumeral (GH) external rotation while breathing inward, holding 1 second and exhaling with a return

of GH internal rotation. This was performed 30x. *Performed sessions 1-5.*

**Cervical Retraction:** Patient seated with an erect/upright posture with her shoulders relaxed. She was instructed to retract the cervical spine until she felt a mild stretch at the cervicothoracic junction. This was held 10 sec x 10. *Performed sessions 1-5.*

**Three finger flexion:** Patient seated with an erect/upright posture and instructed to flex her cervical spine to 3 fingers length from chin to chest. From this amount position, the patient performed 30 rotations to the left and right. *Performed sessions 1-5.*

**Wrist flexor stretch:** Standing arms length away from the wall, the patient held her forearm supinated with wrist in an extended position and palm of hand against the wall. She then slid her hand up the wall to get a stretch at the wrist flexor/pronator group. This was held 10 sec x 10. *Performed session 1-5.*

The program was progressed the following sessions with a focus on restoration of cervical ROM as well as neural mobilizations of the median nerve. The following activities were performed in sessions 2-5 as follows along with moist heat/TENs and manual thrusts as previously described:

**Right sidebending:** Patient seated with an erect/upright posture, and left hand grasping onto the bottom of her chair. She then sidebent her cervical spine to right until feeling a mild pull in the left upper trapezius region. This was held 10 sec x10. *Performed sessions 2-5.*

**Middle and Lower Trapezius strengthening:** The patient was prone with her shoulders off the front of the table. She then performed a "T" for activation of middle trapezius and "Y" for lower trapezius activation. Shoulders were externally rotated for each with thumb pointing up. She performed 2x10 during the 2nd session and progressed to 3x10 during each additional session. *Performed sessions 2-5.*

**Median Nerve Flossing:** These were performed with the patient standing with shoulder abduction and external rotation, elbow extension to 0°, full forearm supination, full wrist and digit extension with the palmar aspect of the hand against the wall. The patient was instructed to sidebent her neck away

from the upper extremity in which the mobilization was being performed. (Note: The shoulder was abducted to the point in which she felt tension and was started in a scapular plane and externally rotated until a gentle pull was felt). *Performed sessions 3-5.*

## OUTCOMES

The patient in this study was treated for 5 sessions. Upon reassessment after the first session, the patient reported a significant decrease of symptoms into bilateral wrists. She reported no numbness or tingling at the wrists and only "pulling" at the base of her neck with end-range motion. She also demonstrated an immediate improvement of 17° of total sagittal plane motion (flexion+extension) following the thrust manipulations.

Following the second session, the patient stated she had no symptoms associated with cervical pain or discomfort into bilateral carpal tunnels. She did present however with positive ULTT bilaterally for reproduction of her chief complaint to the carpal tunnel and her program was progressed to increase mobility of the median nerve.

By the fifth session, over a 13-day period, the patient reported an overall subjective improvement of 95% with decreased pain to 0-1/10 with mild stiffness in the base of the neck and shoulder blades. The patient had no numbness or tingling into her hands. She reported an 8% on the NDI. She demonstrated on a second pain diagram and rating scale that she only had a 1/10 pain in the upper thoracic spine when initiating stretching to perform her home exercise program consisting of the described exercises performed during the first two sessions.

Upon discharge, the patient demonstrated improved cervical sagittal ROM to 120° (55° of flexion; 65° of extension; improved 40° from initial evaluation) and improved mobility of CTJ and upper thoracic segments with Posterior to Anterior glides (P/A) and unilateral PAIVMs. Her strength improved to 4+/5 in the middle trapezius and 4/5 in her lower trapezius bilaterally. She still exhibited a positive ULTT bilaterally but was improved to -30° on each upper extremity versus -75° and -70° on initial evaluation.

## DISCUSSION

This case report was unique in which cervical ROM was restored dramatically

following the initial cervicothoracic and midthoracic thrust manipulations that also appeared to have reduced symptoms at the wrist. This outcome, in addition to other recently published literature, reinforces the idea that thrust manipulations of one area may result in gains of another.<sup>11,19,22,34</sup> Research indicates the positive effects of thrust manipulations in reducing pain but the physiological mechanism in which they work continues to be poorly understood.<sup>8-12,35,36</sup> It has been proposed that there may be biomechanical, muscular reflexogenic, and/or neurophysiological effects that work in reducing pain.<sup>35</sup> One study in particular, found a relationship between performing manipulations to the cervical spine that allowed for increased pain-free resisted gripping on the affected limb in patients with symptoms down to the lateral epicondyle.<sup>36</sup> It is believed that this result likely demonstrates that thrust manipulations stimulate descending inhibitory pain systems that induces mechanical hypoalgesic effects<sup>35,37</sup> and may have been why this patient's distal features decreased with proximally biased treatment. Because the median nerve has motor and sensory contributions derived from nerve roots C6-T1 that can become compressed in the CTJ and the wrist,<sup>14</sup> it is likely that there could have been proximal and distal compression features to this case and that proximal decompression with thrust manipulations decreased symptoms distally almost immediately. It is important to note that in the authors' opinion the thrust manipulations may have provided improved outcomes for performing the median nerve mobilizations in this case.

Although the medical diagnosis of this patient was bilateral CTS, she did not present clinically with typical signs and symptoms related to CTS. We believe the successful reduction of her distal symptoms with proximal treatment indicate that she likely presented with a double crush syndrome. We support this contention based on the effective outcome of treatment proximally, which decreased symptoms distally. A T4 syndrome may also have existed due to location of symptoms as well as her positive ULTT, which improved with the thrust manipulations, median nerve mobilizations, and postural training/stretching.

The over-activity of the upper trapezius muscle could have also contributed to increased tissue resistance with the ULTT.<sup>33</sup> Sterling et al<sup>38</sup> found hyperalgesic responses

bilaterally to upper limb tension testing in individuals with chronic whiplash associated disorder (WAD). This supports the contention that the central nervous system may be hyperexcitable in individuals with WAD and although our subject did not have the history of WAD, she may have had central nervous system involvement due to the positive bilateral ULTT signs.<sup>38</sup>

Bialosky et al<sup>4</sup> published a recent study looking at the effects of neurodynamic techniques (NDT) in the treatment of CTS. In this study, the authors compared neurodynamic mobilizations of the median nerve with sham interventions and found that there were short term improvements in both groups in term of pain and disability which indicates, like other recent studies, that positive clinical outcomes are likely due to manual interventions versus the true setup of intervention.<sup>4,13,39</sup> Bialosky did note an inhibition of temporal summation that was specific to the NDT of the median nerve of individuals with CTS.<sup>4</sup> In this case, we used a combination of manual interventions with the NDT as described by Bialosky. The difference in our intervention of NDT was that we had the patient perform self mobilizations instead of manual neural gliding. With mobilizations of the proximal segments of the cervical/upper thoracic spine, the NDT may have further contributed to decreasing temporal summation of symptoms.

A major limitation of this case report was that this patient's CTS was not diagnosed using electrodiagnostic testing. A clinical prediction rule (CPR) has recently been established to differentially diagnose CTS,<sup>1</sup> but several of the measures used in this rule were not used in this study. When describing what the patient stated subjectively, we must take into account the fact that the patient had a history of depression that may have had an effect on her perception of pain. We did not give the patient any form of pain perception questionnaire, such as the McGill Pain Questionnaire, which has been proven to be sensitive in detecting variable types of pain.<sup>40</sup> Future research could be performed to compare the effects of the thrust manipulations in patients with positive bilateral ULTT through the use of 3 groups: manipulation only, exercise only, and manipulation plus exercise.

Overall, the patient reported her symptoms improved following 5 sessions with treatments focused to the cervicothoracic spine and supporting musculature. We



attribute these improvements to the association we believe that exists between the cervicothoracic spine and increased neural tension bilaterally at the carpal tunnel.

## CONCLUSION

In conclusion, the results of this study demonstrated that a combination of thrust manipulations, neural mobilizations, neuromuscular re-education of periscapular musculature, and nocturnal wrist splints were effective in the short-term outcomes of decreasing pain at the base of the neck and resolving neural tension signs in the carpal tunnel. Future research needs to be performed to identify the physiological treatment/EMG response at the carpal tunnel following more proximal treatments consisting of cervicothoracic thrust manipulations, postural exercise, and neurodynamic techniques. This could be conducted to identify if a true regional interdependence phenomenon exists between the cervicothoracic spine and the carpal tunnel.

## ACKNOWLEDGEMENTS

Special thanks to Chad Cook PT, PhD, MBA, OCS, FAAOMPT, for reviewing and providing input to this case report

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END

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dent and Vice President/Education Chair, respectively for 2011 – 2012. Elections will be held this fall to fill these positions for 2012 – 2015. Please contact the Orthopaedic Section to express your interest in becoming a member of the Imaging SIG.

At the CSM Annual Membership Meeting, the Foundation for Physical Therapy announced that the Orthopaedic Section was selected to receive the 2011 Premier Partner in Research Award. This award recognizes the Orthopaedic Section for its generous and long-standing contributions that have made a substantial difference by supporting the Foundation and its mission of funding physical therapy research. Since the Foundation's inception in 1979, the Orthopaedic Section has donated nearly \$1 million to the Foundation. In 2007, the Orthopaedic Section made a \$500,000 pledge toward the establishment of an endowment fund to support orthopaedic physical therapy research. The Premier Partner in Research Award will be presented to the Orthopaedic Section at the Foundation's Annual Dinner and Dance during the APTA Annual Meeting and Exposition in National Harbor, MD on June 9th. To recognize the past contributions that prior Section Boards have made in support of the Foundation, all prior Orthopaedic Section Presidents will be invited to attend the award presentation.

In 2010 the Orthopaedic Section established Advocacy Grants to support APTA Chapters in advocacy efforts that are of importance to the practice of orthopaedic physical therapy. In the past year, 2 grants, totaling \$10,000 were provided to the South Carolina Physical Therapy Association in support of legislation related to referral for profit and to the Physical Therapy Association of Washington in support of legislation to remove the prohibition on spinal manipulation. For more information on Advocacy Grants that are available in 2011, contact the Orthopaedic Section office at 1-800-444-3982 or by E-mail at tdeflorian@orthopt.org.

An objective of the 2010 – 2014 Orthopaedic Section Strategic Plan is to develop a National Orthopaedic Physical Therapy Outcomes Database (NOPTOD). The NOPTOD will allow Orthopaedic Section members to contribute process and clinical outcomes data that is collected during the course of care provided by physical