Conservative Care Options for Occupational Carpal Tunnel Syndrome

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Purpose and Intended Use

This document updates a 2014 resource developed by the Industrial Insurance Chiropractic Advisory Committee (IICAC) of the Washington State Department of Labor and Industries. It provides concise summaries of published clinical and scientific literature regarding utility and effectiveness of commonly used conservative approaches for work-related carpal tunnel syndrome (CTS); history, examination and special studies, recommendations for supportive, manual, and rehabilitative care including practical clinical resources (useable without licensing/charge in practice for non-commercial use). It is intended to inform care options and shared decision-making. It is not a standard of care, claim management standard, or a substitute for clinical judgment in an individual case. This practice resource does not change L&I coverage or payment policies.

A comprehensive update of available scientific literature on conservative assessment and intervention procedures for carpal tunnel syndrome was conducted by the Policy, Practice, and Quality (PPQ) Subcommittee of the IICAC and department staff during Winter 2023. Literature was reviewed, assessed for relevance and quality and summaries were drafted by consensus of the subcommittee with expert content input from consultants and reviewers. In February 2024, the updated resource was posted for public comment and revision after soliciting input from the Industrial Insurance Medical Advisory Committee and selected relevant professional societies. It was approved for distribution by the IICAC in (TBD). This resource is expected to be updated periodically by the IICAC. Interested parties may submit new published scientific report for consideration for future revisions.

This and other practice resources are available for download at the State of Washington Department of Labor & Industries website. LNI.WA.GOV/treatmentresources

The Department of Labor & Industries' Work-Related Carpal Tunnel Syndrome Diagnosis & Treatment Guideline has additional information, particularly related to EDS and surgery: LNI.WA.GOV/treatmentguidelines

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PRACTICAL APPLICATION POINTS

- Work-relatedness usually involves high force, extreme posture work (e.g. meat cutting, roofing); rarely is low force, repetitive work a cause.
- Typical presentation of median nerve entrapment is burning pain on thenar side, especially after work and at night. Hand diagram is more useful than provocative tests.
- Electrodiagnostic studies (EDS) are necessary for diagnostic certainty, CTS surgery requests, or when time loss (TL) exceeds 2 weeks.
- Continued conservative treatment may be warranted if substantial symptomatic improvement and functional progress is demonstrated.
- Surgical release of median nerve entrapment is typically more effective than conservative measures for moderate-severe cases.

Work-Related Carpal Tunnel Syndrome Summary

Work-related CTS is associated with significant preventable disability. Accurate, timely diagnosis and establishment of work-relatedness is critical to prevent delays and ensure optimal outcomes. Electrodiagnostic studies (EDS), showing delayed median nerve conduction velocity (NCV) across the carpal tunnel provides definitive diagnosis. A wide variety of pathomechanisms in entrapment lends to high symptom variability.[1] Some clinical tests correlate with EDS and are useful with cautious interpretation. Non-invasive treatment is a first-line intervention and between. 75% of patients attain successful outcomes with conservative care in one month of treatment.[2] In the first 1-3 months non-surgical conservative interventions appear to be better than surgical outcomes.[3]
Severe symptoms early on, or an insufficient relief after 6 months of conservative interventions warrants a surgical referral.[3] Response to surgery is similar in the medium to long term as that of standard conservative approaches. Response to either intervention may be better when care begins early.[2, 4] If conservative care is able to keep the worker functional and engaged in daily activities, it may warrant an extended trial.

Case Definition

- Clinical presentation of median nerve entrapment (thenar pain/paresthesia, often after work and at night)
- Work place exposure to known CTS inducing activities
- Corroboration of diagnosis by EDS (the latter is most important when response to conservative care is delayed, time loss (TL) exceeds 2 weeks, and/or CTS release surgery is being considered/authorized)
- Severity based on symptoms where mild to moderate can be managed conservatively.
    - Mild: nerve conduction w/ no EMG findings. No atrophy, weakness, or dermatomal loss.

Evaluation Summary

- Rule-in median nerve entrapment initially with validated clinical methods (symptoms, work exposure, motor function, provocative testing)
- Monitor symptoms, motor function, provocability, and work status to document improvement
- Make an early referral for EDS and/or specialist consult if: a) symptomatic for over 6-12 months prior to claim acceptance, as conservative care is less likely to benefit; b) time-loss exceeds 2 weeks; or c) significant improvement, including ability to work is not attained within the first several weeks of conservative care.

Intervention Summary

- Nocturnal wrist splinting with daytime use as needed to control symptoms when using hands
- Improvement may be hastened with additional mobility interventions (e.g., wrist stretching exercises, wrist manipulation/mobilization)
- For diagnostic and surgical referral (particularly in underserved areas) consider assistance from a care coordinator, e.g., from COHE

Typical Interventions and Approximate Response Thresholds

1-2 wks	3-6 wks	7-8 wks	Beyond 8 wks
Diagnostic • Consider corroboration of clinical impression with EDS **Manual** • Nocturnal splinting • Daytime splint use PRN • Wrist mobilization/myofascial • Systematic stretching, home stretching exercise and gliding • Consider work activity, flow, site modification **Modalities/Meds** • Pulsed ultrasound, low level laser therapy, oral & injected steroids shown to provide temporary relief	**Manual** Increase self-mobility, reduce splint use and passive interventions **Good Improvement** (e.g., hand diagram, pinch strength): decrease splint use, reduce care frequency, increase self-mobility, stretching, continue work modifications or return to normal activity. **Inadequate improvement:** continue splint use 2 weeks, alter additional interventions, & consider additional work modification; EDS required if time loss (TL) > 2 weeks	**Good Improvement** • Progressively decrease splint use, reduce care frequency, increase normal work activity **Inadequate improvement** • review compliance with self-care; consider specialty referral • Continued nocturnal pain, little to no reduction in distribution and severity, continued weakness, continued time loss	**Good Improvement** Increase reliance on self-directed care, splint use as needed. **Inadequate improvement** Specialty referral if not already scheduled

CTS Progress Checklist

Voluntary educational / practice aid – Not an L&I documentation requirement

Assessment / Progress

Initial Intake
Document tasks & wrist/hand positions at symptom onset

Work time before symptom onset: _____ hours
Nocturnal symptoms:
□ none
□ 1-2 nights/week
□ 3-4 nights/week
□ > 5 nights/week
□ mild □ moderate □ severe

□ Baseline hand diagram
- Document areas of hypalgesia

Motor strength
Tip pinch grip: _____
Thumb abduction: _____

Discuss Recovery
Conservative care should maintain their ability to work and function and last only a few weeks before surgical consideration.

Assess Functional Recovery
Reassess hand diagram, physical capacity and time to symptom onset, neurologic tests, and nocturnal symptoms.

Plan
Consider referral for electrodiagnostic studies, and or specialty/surgical referral if not already scheduled after 2-3 weeks.

Assess Functional Recovery
Decreased nocturnal pain, reduced distribution and severity, increased pinch grip, returned to work.

Incrementally Increase Activity
Goal to return to normal work activities and daily routines

Resolution or referral
By this time symptoms should be under control, most activities are normal. If not, surgical referral is indicated.

Clinical Assessment Summary

Occupational CTS Case Definition

Policy Standard for L&I Claim Acceptance

Diagnosis of CTS is straightforward when the symptom presentation matches the classic clinical presentation, coincides with delayed median nerve conduction, and is provoked by specific tests. Unfortunately, up to 70% of CTS patients experience extra-dermatomal distributions.[5] Provocative testing can be a good confirmation, but failure to elicit a response often does not rule out CTS. Care must be taken to properly diagnose CTS and consider common differentials that may lead care down the wrong path. [6-8]

Classic clinical presentation of median nerve entrapment

- Burning pain, paresthesia; one or both hands along median (thenar side) nerve distribution; often more evident after shift/activity or at night. [9]
- Provocative tests (e.g. sustained pressure, tapping over carpal tunnel area) may aggravate symptoms.
- Other causes of wrist/hand symptoms ruled out (e.g., tendonitis, sprain/strain, myofascial and joint dysfunctions, myofascial referral, cervicogenic referral) [9]

Work place exposure to CTS inducing activity [10-13]

- High probability of work-relatedness:
  - Combination of high force & repetition; extreme posture in flexion, extension, and/or deviation (e.g., meat cutting, carpentry, roofing, book binding)
  - Acute trauma to the forearm or wrist
- Medium probability of work-relatedness:
  - Medium force & continuous repetition/awkward posture (e.g. Dental hygienist); sustained vibration (e.g., jackhammer)
- Low probability of work-relatedness:
  - Intermittent low force & repetition (keyboard >20 hr/wk, cashier)

Corroboration of CTS diagnosis by nerve conduction velocity (NCV) testing [14, 15]

- Required by L&I when time loss > 2 weeks
- Needed for confirmation of diagnosis for CTS surgery request
- NCV most useful in long-standing symptoms.
- Refer to L&I CTS guideline for criteria summary[15]

Differential Diagnosis Considerations

While CTS is the most common median nerve compression neuropathy, there are other proximal problems that can create similar symptoms along the median nerve.[5] Peripheral Median Nerve Compressions (PMNC) exist along a continuum of mild to severe lesions along the median nerve at multiple points resulting in a variety of symptom variation. A misdiagnosis of CTS may delay treatment and thus prolong recovery, or lead to unnecessary interventions and harm.

Additionally, other peripheral entrapment neuropathies can present with symptoms similar to CTS due to the wide variety of anatomy and pathomechanisms. Lack of clearly defined dermatomal/peripheral symptom patterns therefore does not rule out entrapment. Similarly, neural provocation tests are not necessarily reliable to differentiate entrapment versus radicular etiology. Bilateral presentation can occur in 60% of patients potentially caused by inflammatory response that spreads to the dorsal root ganglion.[7]

Differential diagnosis options should be thoroughly investigated before arriving at a conclusion and pursing treatment, particularly in surgical cases.[1] Failed CTS surgical release often resulted from misdiagnosis of CTS.[16] Care must be taken to make an accurate initial diagnosis to avoid an unnecessary surgery and delay of care for other conditions.

Important differentials and confounding causes of CTS include[13, 17, 18]:

- Pronator syndrome
- Anterior interosseous nerve syndrome
- Proximal median nerve syndrome
- Thoracic outlet syndrome
- Acute trauma or fracture to the wrist/forearm
- Cervical radiculopathies or radicular pain
- Systemic neurologic diseases (MS, motor neuron disease)
- Inflammatory or autoimmune diseases (rheumatoid arthritis, polyneuropathy)
- Endocrine changes (pregnancy, obesity, diabetes, thyroid)
- Tumors (Pancoast, intraneural ganglia, benign peripheral)

History – Diagnostic/Severity Indicators

Patient Presentation

A series of patient presentations, when all present together, may suggest a higher likelihood of CTS[19]:

1. Hypalgesia in the median nerve distribution
2. Classic or probable Katz diagram results
3. Weak thumb abduction strength

When this set is present, more skepticism should be used, but severity and length of symptoms must be considered[20, 21]:

1. Unlikely Katz diagram results
    - Classic CTS symptom presentation includes burning pain, paresthesia; one or both hands along median (thenar side) nerve distribution; often more evident after shift or at night. 70% of CTS patients exhibit some form of extra-dermatomal pain pattern that may make symptom interpretation inconsistent with the typical pattern.
2. Normal thumb abduction strength

History of high force with repetitive activity, or acute trauma to the forearm/wrist creates higher likelihood of work-relatedness.

Nocturnal Symptoms

- Nocturnal Symptoms: Patient awakes with hand, wrist, and forearm complaints of discomfort, numbness, tingling, and fullness which improve with movement /shaking of extremity.[9]
- The absence of nocturnal symptoms was reported to correlate with negative NCV tests. The presence of nocturnal symptoms occurs in about 2/3 of CTS cases.[19]

Functional Questionnaires[22-25]

- **Carpal Tunnel Syndrome Assessment Questionnaire (CTSAQ)** also known as the **Boston Carpal Tunnel Questionnaire (BCTQ) –** A self-administered symptom severity questionnaire that has been used in population-based research trials for which psychometric properties have been validated. It includes symptom severity and function subscales. It has demonstrated sensitivity to pre- and post-surgery changes in self-reported severity of wrist

symptoms and several basic activities of daily living. It does not appear to have been correlated to NCV findings and does assess typical work tasks or durations [26, 27]. An on-line source for the scale could not be found, but numerous sources for the instrument and information can be found online searching by the instrument names.

- **Michigan Hand Outcome Questionnaire (MHQ) -** Developed to measure the health state domains important to patients with hand disorders. The instrument is used to evaluate a patient prior to hand surgery and after the surgery. It is a lengthy questionnaire mostly used in a research setting. It has been shown have to good validity, reliability, and responsiveness in documenting change in CTS patients.[28] The pain and function domains of MHQ appear to discriminate well between patients who report being satisfied with their surgical outcomes (minimally important change has been reported to be 23, 13, and 8 for pain, function and work domains respectively [29]. A shorter 12-item version has been validated against the original with high responsiveness for all diseases including CTS and across time periods [30]. A brief MHQ version with scoring instructions can be found at
- **Quick Disabilities of the Arm Shoulder and Hand (QuickDASH)** - is a self-report questionnaire designed to measure physical functions and symptoms in people with any of the several musculoskeletal disorders of the upper limb. It is a validated measure with widespread use. Reliability and reproducibility for hand and wrist function have been demonstrated in several studies. Responsiveness of the full DASH questionnaire has been demonstrated to be comparable to the CTSAQ preoperatively and 3 months postoperatively [31]. DASH has also been demonstrated to be comparable in responsiveness to change in CTS patients preoperatively, 3 months and 6 month post-operatively with the MHQ and the Patient Specific Functional Questionnaire [32]. The Quick DASH is available for use at http://dash.iwh.on.ca/conditions-use

Hand Diagram

- **Katz Hand Diagram** - Patient-administered diagram of dorsal & palmar hand marking and characterizing the locations of pain, numbness, tingling or decreased sensation. Validated for diagnostic properties as follows: [19, 33] for
  - Classic: ≥2 out of digits 1,2,3; no palm
  - Probable: ≥2 out of digits 1,2,3; palm OK if not ulnar only
  - Possible: ≥1 out of digits 1,2,3; palm OK if not ulnar only
  - Unlikely: 0 out of digits 1,2,3

  Potentially useful for assessing symptom distribution following intervention, but not specifically validated for that purpose. See Appendix 1

History – Prognostic Indicators

Risk Factors for Prolonged Disability

The following factors may predict greater risk of longer temporary disability and assist in care planning, specialty consultation, determining need for return-to-work assistance from L&I.

- Strenuous hand/wrist activity on RTW
- Twisting end range exposure preoperatively
- Low mental health status
- High preoperative absence from work
- Female gender
- Obesity
- Elderly with more severe symptoms, more likely to have surgery
- Persistent postoperative symptoms
- Long term absence associated with psychosocial factors (low pay, high job stress, low co-worker support, job-insecurity, low employer support)

Clinical criteria on presentation (signs and symptoms based on Levine Scale and CTS-6 scale) correlate well with NCV testing but important psychosocial factors that may influence recovery (depression, heightened illness concern and pain

catastrophizing) did not distinguish between normal and abnormal NCV findings. [34] Pre-operative NCV score severity does not appear to be associated with longer disability duration[35]

Symptom Severity scores and QuickDASH baseline scores may help predict outcomes, with patients that score higher on these measures being more likely to benefit from individualized sessions, psychosocial support, ergonomics and mobilization. Lower severity scores and higher function status predicts satisfactory outcomes with splinting alone and fewer interventions.[23]

Clinical Examination – Physical Exam

Clinical Prediction Rules

While individual physical exam testing can be useful, combining the results of a series of tests can yield greater likelihood of ruling in CTS. When all five of the below conditions are met, this clinical prediction rule results in a very high positive likelihood ratio, which indicates that this set of tests is 18 times more likely to be positive in people with CTS than those without. If patients have less than 2 positive, the negative likelihood ratio is 0.14 making CTS quite unlikely.[36] This set provides the strongest rule-in criteria available:

Positive Likelihood Ratio for all five = 18.3

1. Shaking hands to relieve symptoms
2. Wrist Ratio Index >.67
3. Symptom Severity Scale > 1.9
4. Reduced sensory function of median nerve in first digit
5. Age >45 y/o

Functional Deficit Tests[6]

- **Median Nerve Distribution Hypalgesia -** Decreased sensitivity to pain along palmar aspect of index finger when compared to little finger on same hand. This appears to be highly predictive of NCV findings with good sensitivity and specificity. [19]
- **Weak Thumb Abduction Strength -** Patient raises thumb perpendicular to the palm as downward pressure/resistance is applied to the distal phalanx. Average specificity and sensitivity for finding of weakness. However, a finding of normal thumb abduction strength did not correlate with a negative NCV test. [19]
- **Grip Strength** Tip pinch dynamometry appear to be one of the most responsive, reliable, and valid quantitative non-NCV approaches to target measurement of thenar muscle strength for recovery from CTS surgery. More study is needed however.[37]
- **Thenar Atrophy -** Visual assessment of thenar size. May be NCV predictive in late CTS, but pre-atrophy symptoms usually prompts care seeking, so sensitivity is low. Further, thenar atrophy results from other conditions (cervical radiculopathy, brachial plexus lesions). [19]
- **Square Wrist Sign -** This sign is positive when the ratio of a patient's wrist thickness to wrist width (as measured by calipers) is greater than 0.7 (i.e., wrist is more square shaped than rectangular shaped). In one study 69% of people with NCV confirmed CTS were positive. Limited study to date. [19, 38, 39]

Provocation & Relief Maneuvers

- **Closed Fist Sign -** This sign is positive when an increased sensation of numbness, tingling and perhaps pain is reported by a patient after tightly clenching the affected fist for 60 seconds. Limited study to date. Potentially NCV predictive [19]
- **Pressure Provocation -** Direct (sustained as opposed to tapping) pressure with thumb/cuff over carpal tunnel elicits/exacerbates symptoms. Test is not NCV predictive [19, 40]

- **Phalen's Sign -** Sustained maximal wrist flexion to compress carpal tunnel elicits/exacerbates symptoms. Although commonly employed, the test is not NCV predictive. [19]
- **Tinel's Sign-** Tapping with digit over carpal tunnel to elicit/exacerbate symptoms is a standard widespread test, however its sensitivity and specificity are low and it is not predictive of NCV findings. [19]
- **Flick Sign -** Assessed by historical inquiry. For patients with acroparesthesia (heaviness & numbness as opposed to pain as the primary complaint), relief is obtained by shaking or flicking the affected hand(s). For patients primarily complaining of hand pain, the test may not be predictive. Contradictory and limited studies exist to date. [19, 41, 42]
- **Hand Elevation Test –** Patient raises their hand overhead for a couple of minutes to produce symptoms of CTS. if symptoms are reproduced the test is considered positive. It is reported to be more specific and sensitive than Tinel's and Phalen's test. [43, 44]

Diagnostic Accuracy and utility of physical exam (See Appendix 2 for table)

Both historical symptoms and physical examination relies heavily on accurate interpretation of results in order to shift the probability of the pathologies being considered in the differential. The challenge is that these tests are not perfect, and error is inherent. Not all tests have equal value in both their positive or negative findings and how that relates to predicting accurate diagnoses. Informed clinicians must weigh these results differently based on each test.

When interpreting the above subjective indicators and history elements, positive findings with the Flick sign and a classic/probable Katz diagram is strong in ruling-in CTS, particularly if they also have night time symptoms.
When taken together, an Unlikely Katz diagram, negative flick sign, and absence of morning symptoms are strong in ruling-out CTS.

During physical exam performance, skill in performance and careful interpretation of "positive" tests is necessary. Most of these tests are fair to good at identifying presence of some type of median nerve or peripheral entrapment, but are poor at differentiating CTS from other diagnoses. These same tests are often positive for a variety of upper extremity or median nerve complaints. Care must be taken in interpreting positive findings, which may not indicate CTS. Negative findings on any single exam procedure below is poor at ruling out CTS:

- Hand elevation has good clinical performance and should be the first screening test. While a positive is helpful, it may also be positive in mimics of CTS.
- Hypalgesia is a fairly specific finding for CTS, but needs to be coupled with other findings in Hx and/or exam and does not rule out/in on it's own.
- Square wrist sign is fairly specific for CTS, however, not often found. Absence of it does not rule out CTS.
- Tinel's - is fairly specific for median nerve involvement, but not as specific for CTS and may be positive in other entrapments.
- Phalen's - positive may help when combined with other positive findings but alone is not of value in ruling in or out.
- Thenar Atrophy - Although fairly specific for CTS, it takes several weeks to detect and may be an indicator of poor management or a need for surgery.
- Abduction weakness in the thumb, when found, is helpful with other positive findings but not of value alone and again may indicate more severe condition or delayed care and is not a good early indicator.

Specialized Examination – Electro-Diagnostic Studies

Nerve Conduction Velocity (NCV)[45]

- NCV testing remains the benchmark of median nerve involvement with findings of longer conduction times (slowing) of motor and sensory fibers between the arm and palm compared to other nerves. Without these findings, carpal tunnel surgical release outcomes are poor. Less than 10% of CTS patients have normal NCV findings. Thus NCV is useful for definitive diagnosis of CTS and predicts positive outcome from surgical release when there is an inadequate response to appropriate conservative intervention.[15, 45-48]
- Near or near normal pre-operative NCV findings were associated with poorer post-surgical outcomes in workers with CTS compared to workers whose pre-operative NCV findings indicated median nerve entrapment.[49]

Combined Sensory Index (CSI) for Nerve Conduction Velocity

- CSI combines results of 3 NCV tests at different locations on the hand instead of one location. This approach reduces sensitivity compared to a single test, but increases specificity to 100% when all three tests are included. The use of multiple tests is proposed to improve diagnostic accuracy. [50-52]

Imaging Studies

MRI and CT

MRI and CT are not currently covered under L&I to rule-in or for confirmation of CTS. However, if the diagnosis remains ambiguous following NCV testing and there is a poor response to conservative intervention, advanced imaging may be indicated.

- Both MRI and CT measurements of distal median nerve cross-sectional area were reported as having acceptable diagnostic accuracy compared to clinical criteria (see NCV section above). Because of lower sensitivity and specificity than EMG and the higher cost of MRI or CT, advanced imaging was not recommended for first-line diagnostic confirmation.[46]
- Smaller cross-sectional area of median nerve at hamate level compared to radioulnar level correlates with slower (late) NCV findings. MRI may be able to detect early denervation of muscle as well as renervation. MRI's ability to visualize the extent of space-occupying lesions, signal changes related to denervated and fat infiltrated muscle, diverticulum, and other anatomical change may help clarify diagnosis and disease severity in particularly ambiguous cases that do not respond to conservative care. [53, 54]

Diagnostic Ultrasonography (US)

- Diagnostic ultrasound was reported to have acceptable accuracy (sensitivity 88.4% and specificity 46.2%; $p<0.016$) in comparison to clinical criteria (see NCV section above). Because US interpretation is subject to greater qualitative interpretation, NCV/EMG was considered the best first-line confirming diagnostic test. [46] [55]

Prognostic and Management Issues

Prognostic Indicators

- A paresthesia score <6 nights PLUS < 1 year complaint duration correlate with greater success with splinting (moderate positive predictive value of 78%). [56]
- Less nerve involvement on NCV may predict greater success with conservative care; shorter duration of symptoms tends to yield better outcomes (but was not significant); younger age & relief of symptoms beginning within 5 months predicts better success. [47]

Progress Assessment & Functional Ability[57]	Meaningful, measurable improvement (compared to baseline levels) is expected in the following areas within 6-8 weeks following onset of conservative treatment: • Increase duration of work activity without symptom onset • Decreased incidence and severity of nocturnal symptoms • Reduction in symptomatic areas of hand diagram • Less hypalgesia (increased sensitivity to sharp stimulus) in palmar surface of index finger • Tip pinch grip strength and thumb abduction strength may have potential to evaluate improvement but should not be used in isolation Splinting alone has been shown to lead to improvement within 5-36 months across different studies. Studies adding other conservative intervention appear to document improvements within 1-2 months. [47, 56, 58]
Surgical Timing	Conservative care should not be delayed, even if surgery is considered. Early intervention with conservative care showed the best post-operative outcomes, even among patients with CTS symptoms up to two years.[59] Findings of median nerve involvement on NCV strongly predict good outcomes with CTS surgery, therefore early acquisition of NCV should be routinely considered, particularly if CTS interferes with ability to work and/or meaningful improvement with conservative interventions is not evident within approximately 6-8 weeks of beginning care, or if insufficient relief is obtained by 3-6 months of care.[3] Complications from prolonged disability can significantly outweigh other considerations. [4, 47, 56, 60-65]

Workers' compensation issues

Causation & Work Relatedness	Likely work exposures typically involve: Medium to high force gripping and repetition, extreme prolonged end-range wrist flexion, extension, or deviation, sustained vibration. (See Case Definition above). [66] Exceptionally clear medical justification for specific work exposure(s) is essential for fair and timely decisions. Delayed adjudication and development of adversity in work-related carpal tunnel cases has been associated with poor outcomes. Disability from CTS in Washington workers may be related more towards non-clinical factors (e.g., delays, adversity) than to clinical ones (e.g. severity). Other factors that may indicate increase risk of long term disability include activity intolerance, fear of re-injury and low recovery expectation. [67, 68] In Washington State, occupational conditions that may be a result of cumulative workplace exposure across multiple employers may have claim and experience costs apportioned to both former and current employers. Worker and employer appeals rights can factor into adjudication decisions and contribute to delays which are associated with worse outcomes. [69, 70]
Early Accepted Diagnosis of CTS Claim	CTS diagnosis occurring months after claim filing has been shown to be associated with additional medical problems and longer disability periods. For better outcomes, early definitive diagnosis is needed. [61]
Return to Activity/Work	Consider average post-surgical healing and functional status. Return to Activity (RTA) following CT Release was 15 days, and Return to Work was 25.6 days[71] RTW factors are highly variable and strongly influenced by patient and physician specific factors.[71] Consider carefully any psychosocial barriers and appropriate recovery messages.
Physical capacity/Work restrictions	Re-exposure to repetitive movement and heavy manual handling following CTS surgery correlates with a longer period before return-to-work.[72]

CTS Conservative Interventions Summary

Conservative CTS* Intervention Strategy[7, 73, 74]

*See CTS case definition on CTS Assessment Elements

Many individuals with carpal tunnel syndrome (CTS) continue to work with the condition and respond well to non-surgical interventions. Primary importance for conservative interventions is rapid and sustainable relief. If CTS interferes with ability to work and/or meaningful improvement with conservative interventions is not evident within approximately 6-8 weeks of beginning care, consider NCV or surgical consultation. Complications from prolonged disability can significantly outweigh other considerations. [47, 56, 60-65]
But even during the wait for alternative management options, early conservative care improves outcomes for patients post-operatively across a variety of timeframes.[59]

Various conservative interventions have been studied with neutral splinting being the most rigorously studied, thus this should be central to any conservative treatment plan. Various combinations of other conservative interventions have also been studied mostly in lower quality studies and several appear to be comparable options when used with splinting. Among the conservative interventions most likely to be of additional benefit are carpal bone mobilization, systematic stretching exercise (e.g., yoga, nerve gliding), pulsed ultrasound and low level laser therapy. These interventions typically last between 2-8 weeks in the literature. Most non-surgical interventions for carpal tunnel provide relief in the short and moderate term. Oral and injected steroids have been shown to provide short term relief but half of patients treated this way undergo surgery within 1 year.[60, 63, 75-77]

Overall, the non-surgical interventions such as splinting, exercise, and mobilization have limited, low to medium quality evidence of significant benefit for improving symptoms, functional ability (e.g., hand grip strength), quality of life, and neurophysiologic parameters, and for minimizing adverse effects and the need for surgery in people with carpal tunnel syndrome.[78, 79] Cost-effectiveness data is showing that a combination of manual techniques, lateral glides to the cervical spine, along with tendon and nerve gliding exercises may be more effective and less costly than surgery.[80]

Strong and moderate evidence was found for corticosteroids (oral or injection), and corticosteroid injection seems to be most effective only in the short term with rare additional risks.[81, 82] Physiotherapeutic modalities like ultrasound and low level laser used as an intervention to improve symptoms and recovery showed some effectiveness in the short term.[63, 64, 83]

Splinting

In general, a neutral-position splint at night or during activities that provoke symptoms is beneficial for pain relief/prevention and functional improvements as compared to other more invasive procedures like corticosteroid injection. This conservative approach also decreases the risk of adverse events and the psychological burden of invasive treatment. Orthoses appear to reduce the likelihood of surgery by ~50%.[75, 84]

- Small sample studies indicate that splinting provided symptom relief and neurophysiological improvement that lasted up to six months after follow up.[85]

Splinting positions and materials

- Neutral splinting is the most researched and beneficial, with extension (cock-up) splinting of 20 degrees failing to provide as much symptomatic relief as splinting in a neutral position.[86]
- Both soft and rigid neutral splints have evidence of effectiveness as long as they immobilize the wrist and 2-5 metacarpals. Neither individual or traditional orthoses had significant differences in outcomes.[87]
- Flexible kinesiotaping may be beneficial over splinting alone, but results are mixed.[7]

Timing of splinting

- Nocturnal-only neutral position splints provided short and long term success in symptom reduction in patients who report less than 1 year's duration of CTS symptoms. Greater median nerve involvement on NCV predicts less benefit and splinting does not seem to affect NCV results.[56, 88-91] Nocturnal splinting seems most effective over the first 6-12 weeks, with little additional benefit after that.[13, 92]
- Limited evidence indicates significant differences favoring full-time split use for symptom control over nocturnal-only use with improvements in distal latency, symptom severity, and functional questionnaire measures at 6-week follow-up.[47, 93]
- Intermittent splinting during work hours is commonly employed for symptomatic comfort for some people and as an ergonomic aid to prevent repetitive end range motion. Several studies show benefit of daytime use for symptom avoidance. Most trials incorporate the addition of nocturnal use.[47]

Manual Therapy

A variety of manual therapy interventions are effective on pain/CTS symptoms and physical function, while to a lesser degree on nerve conduction studies.**[73, 94, 95]** Common techniques include a variety of nerve and tendon gliding techniques that may also become home exercises, manipulation or mobilization of the carpal bones, and soft tissue therapies. Often it is difficult to separate out which therapies are the most beneficial and selection can be appropriately guided by patient preference and response to a trial of care. In several trials, combined multimodal conservative care approaches that include some form of manual therapy, splinting, and physiotherapeutic outcomes have failed to demonstrate meaningful differences between groups in primary outcomes like pain and function.[96, 97]

Manipulation & Mobilization

Manipulation

- No high quality studies have specifically compared HVLA extremity manipulation to other interventions for carpal tunnel syndrome, although various case studies have reported improvement in outcomes such as grip strength and NCV measures.[98-100]

Mobilization

- Comparisons of carpal bone mobilization, median nerve region mobilization and no treatment control reported statistically significant improvement in pain scores in both treatment groups over the control group but failed to show a difference in ROM and VAS to be statistically significant between the two treatment groups [101]
- One small study included cervical lateral glides as part of their successful treatment protocol, but no comparison without cervical glides is present.[80]
- Mobilization with movement (MWM) technique improved activity pain, and function outcomes compared to standard physiotherapy.[102]

Mechanical Traction

- Mechanical traction to the wrist using a device appears to be beneficial with up to 12 treatments, but not comparison was made to other manual therapy procedures which appear to benefit in similar timeframes.[103]

Neuromobilization

Nerve flossing / Neurodynamic technique / Neural mobilization

Moving the median nerve through its bony and fascial tunnels and constricted pathways has taken many names and variations. Neural mobilizations appear to restore longitudinal and transverse excursion of the median nerve and desensitize the structures.[73, 104-106] Significant outcomes on symptoms, function and NCV findings are found when compared to sham or control groups.[107] Addition of neuromobilization to standard care sees benefits in decreasing pain and increasing functional activities, although it may not have additive effects if other kinds of tendon gliding and manual therapy are already part of care.[55, 108-111] As little as 3 visits over 3 weeks has shown 70-75% resolution in some instances.[2, 112]

Soft Tissue Techniques

Massage, trigger point, etc

Massage - 12 sessions of massage targeted specifically to probable nerve entrapment sites was more effective than general relaxation massage (neck, back, upper extremities) in improving grip strength (sustainable 4 weeks after last Rx). Both groups demonstrated similar improvement on subjective tests. Selection criteria was unverified clinical diagnosis did not require NCV testing.[113]

Instrument assisted soft tissue mobilization compares equally to manual soft tissue techniques (Graston technique®) with home stretching & strengthening exercise was compared to manual soft tissue and joint mobilization with home stretching and strengthening exercise with 10 treatments over 6 weeks. Both groups demonstrated statistically significant improvement at the end of the treatment protocol and at 3 month follow-up compared to baseline scores on nerve conduction studies and self-reported symptom severity and hand function ratings. There was no statistical difference between groups.[114]

Exercise

Several types of hand and wrist exercises have been used to treat CTS, most prominently three kinds of mobilizing and stretching approaches:

Nerve gliding exercises (NGE) incorporate positional movements to stretch digits (individually and in groups) along with the wrist and forearm. Typically applied for a specified number of repetitions, the exercises theoretically traction the median nerve though the fascia along its course. Small studies support the use of NGE as a potential addition to standard CTS therapy to improve outcomes. [115] [116] [117] One study indicates that the addition of NGE may reduce surgical rates by ~30%. [112]

Six positions include 1) neutral clenched fist; 2) neutral extended fingers and wrist; 3) extended fingers and wrist with thumb in neutral position; 4) wrist fingers and thumb in extended position; 5) wrist, fingers and thumb extended with wrist in fully supinated position; 6) wrist, fingers in neutral position with thumb passively stretched in abduction using opposite hand.

Tendon gliding exercises (TGE) use active mobilization through full ranges of hand and finger motions aimed at enhancing tendon movement coursing through the wrist. TGE appear to enhance outcomes for pain, range of motion and function when added to standard care for CTS. [55, 115]

- Five discrete positions include:
  1. Straight – neutral wrist, fingers extended;
  2. Hook – hand in neutral position with distal digits fully flexed
  3. Fist – fully closed position, all inter-phalangeal joints fully flexed;

4. Tabletop – wrist straight with fingers flexed only at the metacarpal-phalangeal joints;
5. Straight fist- wrist neutral with flexed metacarpal-phalangeal and proximal inter-phalangeal joints; distal inter-phalangeal joints extended.

Generic stretching exercise approaches to therapeutic exercise including yoga and other light stretching activity particularly to the forearm and carpal ligaments appear to be effective, but not more so than therapist-led interventions.[118-120]
In a systematic review of articles focused on work-related conditions, they concluded that there is evidence that exercise, particularly when individualized to the patient (rather than a group), may be more beneficial than massage for upper extremity complaints generally. Data was inadequate to differentiate between different types of exercise.[121]

Injected & Oral Steroids

Corticosteroids are in fairly common use for treating musculoskeletal pain, including CTS [122]. Short-term symptomatic relief has been demonstrated with steroids, but it is unclear if steroids provided sustained benefit in the long term.[60, 81, 123] NSAIDs, diuretics, and vitamin B6 provide no better relief than placebos.[58, 124]
Steroid injections have been shown to be somewhat effective in improving NCV and symptoms for mild to moderate cases with or without abnormal NCV findings.[125, 126] Ultrasound guided may have more beneficial outcomes than landmark guided injection. Injectable steroids may have better outcomes than oral, particularly in short-medium term, but neither has lasting long-term effects.[127, 128]

In all cases, night splinting should be done as it may be just as effective as steroid use while preventing continuation of the mechanical problems.[129]
About half of patients treated with steroid have surgery within 1 year, the other half not requiring further injections. Injections may delay the need for surgery and reduce its rates but may not be a cost-effective early intervention compared to splinting.[129-132]

Adverse events of long term steroid use cause this to not be recommended for more than 1-2 injections in the L&I CTS guideline.[133] Both proximal and distal injection locations appear to have similar outcomes. [134] Both injections and oral steroids often fail to show improvement over night splinting past 1-3 months.[129, 135] Past this point, steroids perform poorly: at 3 months, 34% of hands had symptom relief. At 6 months, 23% had improvement and 11% had improvement at 12 and 18 months.[136, 137]

Physiotherapeutic Modalities

Ultrasound – The overall safety and benefit of therapeutic ultrasound for people with carpal tunnel syndrome reveals that there is only poor quality evidence from very limited data to suggest that therapeutic ultrasound may be more effective than placebo for either short- or long-term symptom improvement in people with carpal tunnel syndrome. There is insufficient evidence to support the greater benefit of one type of therapeutic ultrasound regimen over another or to support the use of therapeutic ultrasound as a treatment with greater efficacy compared with other nonsurgical interventions for carpal tunnel syndrome, such as splinting, exercises, and oral drugs.[138]

Phonophoresis and Iontophoresis – Comparisons of splinting with sham ultrasound or ketoprofen phonophoresis have shown Ketoprofen PH as adjuvant therapy on splinting is effective with respect to reduction of pain, but similar improvements were made in functional metrics with sham and ultrasound. [139] Similarly positive, but non-superior outcomes occur with corticosteroid phonophoresis when compared to common interventions like low level laser,

ultrasound, and standard care.[140-143] Comparison groups of phonophoresis and iontophoresis had ~30% improvement on electrodiagnostic studies compared to ~70% improvement with corticosteroid injection.[130]

Paraffin bath therapy – The evidence for this modality is limited to small trials using it as an adjunctive therapy. [144]

Low level laser therapy – [145-148] Systematic reviews show that laser has a demonstrable, if low level, physiologic outcome in improving symptoms and NCV findings which typically has a very short term duration.[7, 149] When laser is added to standard outpatient therapy for CTS involving splinting, exercise and manual therapy improvements are seen on symptoms and functional hand outcomes across several studies.[150-152] Laser may do as well as ultrasound and/or better. Adding laser appears to improve outcomes over splinting alone, with no differences in low or high powered laser.[153]

Acupuncture

Systematic reviews of the effectiveness of acupuncture for CTS found no firm evidence that acupuncture was effective in the treatment of symptomatic CTS.[154-156]

Workers' Compensation Intervention Issues

Employer Contact

Early provider contact with employer to asses and establish needed accommodation may be associated with reduced long-term disability in occupational conditions generally. [157] Accommodation for modified work (administrative, ergonomic) may be primarily a post-surgical consideration, since lower work demands predict better return to work following surgery.[158] [159] Adding breaks to computer work are reported to provide benefit in reducing CTS symptoms compared to no breaks.[160]

Care Coordination

Washington State experience suggests that adoption of occupational health best practices, including timely diagnostics, assistance with coordination of care from resources within Centers of Occupational Health and Education can improve outcomes with CTS and other musculoskeletal conditions. [157]

Ergonomic Interventions

- Force displacement keyboards, or alternative geometry keyboards appear to be of limited benefit for symptom improvement for work-related arm, neck and shoulder conditions. Other ergonomic modifications have not been shown to provide benefit in reducing CTS symptoms.[160]
- Breaks during computer work appear to have limited evidence for effectiveness in reducing symptoms associated with work-related arm, neck and shoulder conditions. [160]
- Alternative keyboard designs & keypad configurations may offer improved comfort but have no impact in preventing CTS. [161]
- Multiple component interventions (plant-wide workstation redesign, establishment of an ergonomics task force, job rotation, ergo training, and restricted duty provisions) have been shown to reduce work-related musculoskeletal disorders (WRMSD) in some studies, with direct employee involvement in job redesign potentially increasing the benefit. [160]

Work Rehabilitation Interventions

Work hardening for CTS has been associated with 83% return-to-work following treatment; 90% of these patients reported being able to return to work despite some pain.[162]

	Multidisciplinary program group ((physical and work conditioning, work and stress management, workplace ergonomic counseling) had a significant increase in cases returned to work (74% vs. 40%) and who returned full-time (91% vs. 50%) compared to usual care PCP with physical medicine- (PT/OT, DC, etc.). [163]
Return-to-Work Assistance	If a worker has difficulty in returning to work, return to work assistance may be helpful to address some factors. Additional assistance may be needed to prevent longer temporary disability periods if: • Strenuous hand/wrist activity on RTW [72, 158, 164]. • Twisting end range exposure pre-op [165]. • Low mental health status; high pre-op absence, persistent post op symptoms [158]. • Female gender [165]. • Long term absence associated with psychosocial factors such as low pay, high job stress, low co-worker support, job-insecurity, low employer support [72, 166]. • Fear avoidance, low recovery expectation. [68] A study on the determinant of return to work after carpal tunnel release is job type, but psychological factors such as patient expectations, and catastrophic thinking, and anxiety in response to pain also have a role. [72, 167]
Personal Controls	Separately implemented personal controls (e.g., WRMSD education, flexible splint use, EMG biofeedback, on-site exercise program) appear to be of no benefit in preventing CTS. Authors suggested that the combination of these controls with either engineering or administrative interventions may be more successful. [161]
Workflow/task Modifications	There is abundant literature opinion on various work flow modifications, but well done studies demonstrating clinical benefit or reductions in CTS incidence were not identified with the current search strategy. Two work organizational factors were associated with an increase incidence in CTS symptoms: payment on a piecework basis and work pace that is dependent upon an automated system. This helps to support the need to look at the pace of work when developing task modifications.[168]
Documentation of Progress while working	Symptom distribution using hand diagram and tip pinch strength should be re-assessed at approximately 2-4 week intervals. Improvement in symptom onset, duration, nocturnal paraesthesias, pinch strength, ability to work, ability to reduce dependency on splints and passive care should be strongly evident within the first 8 weeks of care. If not, consideration is warranted for EDS and specialty consultation.

Carpal Tunnel Syndrome Materials and Resources

Electrodiagnostic Testing

Nerve Conduction Velocity (NCV) – Findings corroborative of a CTS diagnosis: [50, 169-173]

Median motor distal latency (8cm) Note: If median motor distal latency is abnormal, then ulnar motor distal latency at 8 cm must be within normal limits (WNL) (≤ 3.9 msec).	≤ 4.5 msec
Median sensory distal latency 8 cm recorded (palm to wrist) OR 14 cm recorded (index, long, or ring finger to wrist) If either of these tests is used alone, at least one other sensory nerve in the ipsilateral hand should be normal.	< 2.3 msec < 3.6 msec
Median – ulnar motor latency difference (APB v. ADM) at 8cm	≤ 1.6 msec
Median – ulnar sensory latency difference to digits (14 cm) Index or long finger compared to ulnar recorded at the small finger, or –median-ulnar difference recorded at the ring finger	≤ 0.5 msec
Median-ulnar sensory latency difference across the palm (8cm)	≤ 0.3 msec
Median-radial sensory latency difference to the thumb (10 cm)	≤ 0.6 msec
Combined Sensory Index CSI is calculated by adding the 3 latency *differences* above: CSI = (median latency at 14cm – ulnar latency at 14cm) + (median latency at 8cm across palm – ulnar latency at 8cm across palm) + (median latency to thumb at 10cm – radial latency to thumb at 10cm)13 14	≤ 0.9 msec

Needle Electromyography (EMG) – Needle EMG may sometimes have a role in electrodiagnostic evaluation (surface/non-needle EMGs are not covered):

- Nerve conduction studies consistent with CTS, with wasting or substantial thenar weakness; or median motor nerve conduction study is significantly abnormal
- Suspected alternate diagnosis or comorbidity (e.g., diabetes)
- Acute crush injury or other major trauma to the distal upper extremity
- Proximal symptoms (e.g., neck stiffness, radiating pain) suggesting cervical radiculopathy.

Quantitative Sensory Testing (QST) – QST is not covered in Washington workers' compensation. Sensory function (vibration, temperature, pressure) may be useful in investigational settings to differentiate between patients with and without neuropathy. However, QST cannot localize peripheral nerve lesions and is not diagnostic for evaluating specific entrapment neuropathies.[174]

Evidence & Methodology

Literature Retrieval and Review

1. **Initial systematic searches** of electronic databases (e.g. PubMed). Search terms used typically included MeSH terms for tests and interventions with conditions being addressed. Follow-up searches also included population attributes (e.g., workers compensation, occupational).
2. **Abstract screening** for relevance.
3. **Original paper retrieval** with review for relevance, quality, outcome meaningfulness, and effect magnitude.
4. **Additional studies identified** through clinical summaries (e.g., reviews, texts), citation tracking, and feedback from public.

About Evidence for Physical Examination and Conservative Interventions

Conservative musculoskeletal care is typically care of first resort based on long standing practices. Typically 'low tech,' low cost, with minimal and rare side effects, it is frequently delivered in primary care settings, and by various health providers. The rigor and quality expected of high cost, higher risk, emerging, and tertiary interventions is less common for many routine physical examination procedures and conservative interventions. Much of the evidence summarized here would be considered Class "C" or "III" in ratings systems. Thus, the committee has not presented explicit *recommendations*, rather, *evidence summaries* guided by expert consensus to assist in formulating care options. Further, significant emphasis is made regarding tracking and documenting meaningful functional improvement with patients. Study attributes most likely to strengthen or limit confidence are characterized in the evidence descriptions.

Assessing Study Methodologic Quality

Attributes of study methodology quality vary according to the clinical procedure (eg, diagnostic, therapeutic intervention) looked at, and specific research questions being studied. The American Academy of Neurology's Clinical Practice Guideline Process Manual [175] offers a comprehensive guide to systematic evidence review, quality attributes and consensus process that generally serves as the approach taken by IICAC.

General attributes identified when extracting evidence from studies include identification of population, the intervention and co-interventions and outcomes being addressed in each study. The clinical questions addressed such as diagnostic accuracy, therapeutic effectiveness, or causation are determined. Studies are extracted into evidence tables including quality attributes and/or ratings which are reviewed both by department staff and committee members (usually 2 per study).

Specific quality attributes include: Diagnostic Accuracy – design, spectrum of patients, validity and relevance of outcome metric; Therapeutic Interventions – comparison groups (no treatment, placebo, comparative intervention), treatment allocation, blinding/masking (method and degree: single, double, independent), follow-up (period and completion), and analysis (statistical power, intent-to-treat). Specific attention is paid to several factors including reporting of outcomes (primary vs. secondary), relevance of outcome (e.g., function versus pain), and meaningfulness (clinically important change versus minimally detectable change).

Synthesizing Evidence

Consideration of study quality (class), significance (statistical precision), consistency across studies, magnitude of effect, and relevance to populations and procedures were taken into account in preparing draft summaries. Special attention was given to clarifying conclusions related to the clinical questions of interest. Evidence, particularly with low tech and highly diffused examination and conservative procedures addressed here, is rarely truly "definitive," even when multiple studies exist. Inconsistent conclusions typically reflect error (systematic, random) and/or bias in studies. Data pooling via meta-analysis is useful to reduce random error when studies are of sufficient power and methodologic strength. Larger meaningful effect size may increases confidence in findings.

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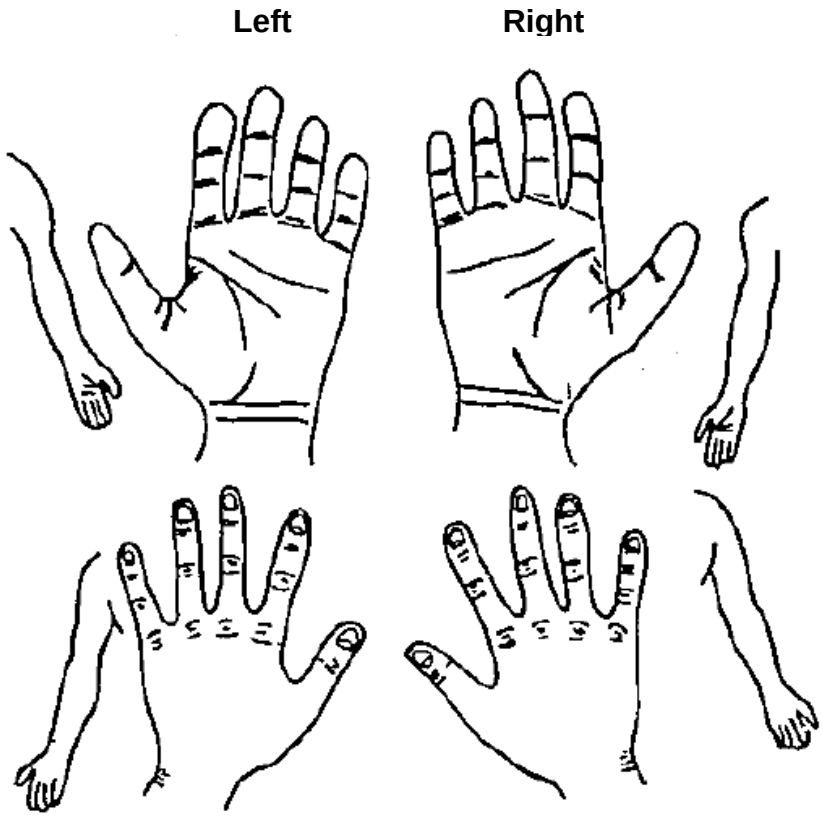
Appendix 1: Hand Diagram

HAND DIAGRAM
requirement

Voluntary educational / practice aid – Not an L&I documentation



Patient Name_____

Claim # _____ Date: _____

LEGEND

Pain	_____ _____ _____
Tingling	| | | | | | | | | | | | | | | | | | | |
Numbness	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
Decreased Sensation	X X X X X X X X X X X X X X X X X X X X

FOR OFFICE USE
COMMENTS:

INTERPRETATION:

Validity of these patterns to correlate with NCV is good:

- Classic: ≥2 out of digits 1,2,3; no palm
- Probable: ≥2 out of digits 1,2,3; palm OK if not ulnar only

* Permission to use this hand diagram was obtained from Dr. Jeffrey N. Katz. The legend was modified for better readability.

Appendix 2: Examination Relative Strength comparison

Legend: Note: These are based on a range determined through the combination of multiple studies for each finding and present a subjective, relative indicator of strength [35, 176, 177]

- = Not determined

*	None
**	Minimal
***	Good
****	Excellent

Hx/Test Finding	Sensitivity	Specificity	+ LR	-LR	Comment
SUBJECTIVE					
Flick Sign	***	***	***	****	Negative finding with Unlikely Katz diagram helpful in ruling-out
Unlikely Katz Diagram	-	****	-	****	Positive finding with Negative Flick sign helpful in ruling-out
Classic/Probable Katz Diagram	***	***	***	**	Positive finding with Flick sign helpful in ruling-in
Nighttime/Morning Symptoms	***	**	**	*	Positive finding coupled with Flick sign and Classic/Probable Katz diagram helpful in ruling-in
OBJECTIVE					
Hand Elevation	***	**	***	*	Good clinical performance and should be the first screening test but may be positive in mimics of CTS
Hypalgesia	**	***	***	*	Fairly specific finding but needs to couple with other findings in Hx and/or exam
Square Wrist Sign	**	***	***	**	Fairly specific, however, not often found
Tinel's	**	***	**	*	Although fairly specific for median nerve involvement, not as specific for CTS
Phalen's	**	**	**	*	A positive Phalen's may help when combined with other positive findings but alone is not of value
Thenar Atrophy	*	****	**	*	Although fairly specific for CTS, it takes several weeks to detect
Abduction Weakness	***	***	**	*	Abduction weakness when found is helpful with other positive findings but not of value alone