



## **Standard of Care: Carpal Tunnel Release**

### **Case Type / Diagnosis**

Carpal tunnel syndrome (CTS) is certainly the most common and frequently diagnosed nerve entrapment, and as such, carpal tunnel release (CTR) is one of the most common surgical procedures for nerve release seen by both Occupational and Physical therapists. For this standard of care, CTS is defined as the symptoms manifested when the median nerve, the major sensory and motor nerve of the hand, becomes compressed as it travels from the forearm to the hand through the carpal tunnel. CTR involves opening the tissues surrounding the wrist, thereby reducing the pressure causing median nerve compression. To best understand this syndrome, and its surgical management, the anatomy of the carpal tunnel and the median nerve, along with a basic understanding of the types of releases performed will be explained.

### **Anatomy:**

The Carpal tunnel is a canal formed by bone and ligamentous borders at the wrist, through which the nine-flexor tendons (4 flexor digitorum profundus, 4 flexor digitorum superficialis, and the flexor pollicis longus) and the median nerve pass. The floor of this tunnel is an arch formed by the carpal bones, the top of the tunnel is known as the flexor retinaculum, or the transverse carpal ligament. Radially, this ligament attaches on the scaphoid tuberosity and the trapezium, and to the pisiform and the hook of the hamate on the ulnar side. In a healthy tunnel, the synovial sheaths surrounding the tendons act as protective padding for the median nerve as it travels through the canal. However, as the demands of the tendons increase with activities of daily living, this protective cushion can become more fibrous in nature, which made lead to entrapment, and or crushing of the median nerve.

The median nerve's distribution in the hand is also important to understand, as this may have a direct correlation to the patient's symptoms. After exiting the carpal tunnel, the median nerve divides into five digital branches. The motor branches supply the thenar musculature, and the 1<sup>st</sup> and 2<sup>nd</sup> lumbricales. The other branches are sensory, and supply sensation to the 2nd and 3rd digit, the radial ½ of the fourth digit, and the thumb.

### **Symptom Presentation:**

Patients with CTS often describe numbness rather than pain to the median nerve distribution consistent with the compression of the median nerve. A clinician should be aware however, that some patients would complain of dysesthesia of the entire hand and not just the thumb, index, middle, and radial half of the fourth digit. This is due to the possibility of variable innervations of the median nerve, as well as the patient's subjective difficulty interpreting these symptoms.

## **Standard of Care: Carpal Tunnel Release**

<sup>1</sup>Patients typically report sleep disturbances due to nocturnal paresthesias or burning pain that may occur from flexed positioning of wrists during sleep. As this condition progresses, patients may feel tingling during functional and or occupational activities during the day. Decreased grip strength is a typical complaint, and may make it difficult to form a fist, grasp small objects, or perform other manual tasks.

In chronic and or untreated cases, the thenar muscles will begin to atrophy, as they lose innervations from the median nerve. Motor symptoms, that is, loss of thumb opposition and abduction, as well as thenar atrophy generally appear late in the course of CTS. <sup>2</sup> Sensory testing may demonstrate diminished or absent of tactile sensation. For example, a patient may not be able to tell the difference between hot and cold by touch of the affected hand.

### **Causes of Carpal Tunnel Syndrome:**

CTS is caused by factors that increase pressure on the median nerve, causing entrapment of the nerve, or in extreme cases, ischemia of the median nerve. The most common cause of CTS is an idiopathic nonspecific flexor tenosynovitis that may simply arise from chronic repetitive occupational stress. <sup>3</sup> Other contributing factors include trauma or injury to the ipsilateral upper extremity that causes edema. Individuals with diabetes or other metabolic disorders such as over activity of the pituitary gland and hypothyroidism are more susceptible to compression. Mechanical problems in the wrist joint, work stress, repeated use of vibrating hand tools could lead to nerve compression. The presence of rheumatoid arthritis could lead to alterations of the bony margins of the carpal tunnel. The development of a cyst or tumor in the tunnel could also lead to nerve compression.

### **Demographics:**

It is interesting to note that women between 40 and 60 years of age are three times more likely than men to develop CTS. <sup>3</sup> This could be because the tunnel itself maybe smaller in women than in men. This also may be due to fluid retention during pregnancy or menopause. The dominant hand is usually affected first and produces the most severe symptoms. <sup>4</sup> CTS usually occurs only in adults.

### **Indications for Surgical Management Of CTS:**

Patients who are surgical candidates generally report symptoms of CTS as described above. The usual indication for surgical treatment is the pt's report of a lack of significant improvement, or worsening of their symptoms. A large retrospective follow-up study of idiopathic CTS patients showed that among those treated non-operatively, the average duration of symptoms was between 6 and 9 months.<sup>7</sup> Should symptoms persist post 9 months, and a course of non-surgical

### **Standard of Care: Carpal Tunnel Release**

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treatment (please refer to CTS SOC) has failed, surgery is often recommended. Below are clinical observations and objective assessments that would be indications for surgical decompression of the median nerve. Increasingly severe deficits noted during clinical observations are proportional to the degree of nerve damage and the duration of compression.

- Pronounced thenar muscle atrophy
- Loss of finger dexterity
- Semmes-Weinstein mono-filament testing is + for “loss of protective sensation” or “absent sensation” (Please refer to Sensory SOC for description of Semmes-Weinstein test)
- Loss of two-point discrimination (Please refer to Sensory SOC for description of Two-point discrimination test)
- Severe pain (> 8/10 on the patient pain analog scale)
- Positive electrodiagnostic tests
- Long term (>9months) impaired function in daily activities

### **Carpal Tunnel Release Surgical Procedures:**

#### Open Carpal Tunnel Release

Open carpal tunnel release surgery is the traditional procedure used to correct carpal tunnel syndrome by the decompression of the median nerve. Decompression is achieved via an incision through the transverse carpal ligament, thereby enlarging the carpal canal and relieving the compressive force on the median nerve. A palmar longitudinal incision is curved along the axis of the ring finger, between the thenar and hypothenar eminences. The incision should extend distally enough to allow for complete division of the transverse carpal ligament while not injuring the palmar cutaneous branch of the median nerve or the superficial palmar arterial arch.<sup>7</sup> The underlying transverse carpal ligament is then divided longitudinally along its ulnar aspect.<sup>7</sup>

Sectioning the transverse carpal ligament has been shown to change the carpal canal from the normally oval shape to a more circular cross section, and has demonstrated a mean 24% increase in the diameter of the carpal canal.<sup>7</sup> Open release via this incision remains the predominate procedure, as this technique affords full inspection of the transverse carpal ligament, the contents of the carpal canal, and the ability to observe for possible anatomic variations of the median nerve.<sup>7</sup>

#### Endoscopic and Miniopen Carpal Tunnel Release:

Newer techniques for transecting the transverse carpal ligament utilizing less invasive techniques has been developed to lesson the possible complications of the open procedure. The

3

### **Standard of Care: Carpal Tunnel Release**

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performance of endoscopic surgery is completed by transecting the transverse carpal ligament through small incisions, often placed outside the palm, away from the high-contact surface of the hand.<sup>7</sup> Endoscopic release techniques of the transverse carpal ligament involve an incision approximately 1cm proximal to the distal wrist crease. The one-portal releases utilize this incision only. There is also a technique that utilizes two portals, the incision at the wrist, and a small palmer incision. The one and two portal releases use a variety of specially designed endoscopic devices to release the transverse carpal ligament.

Proponents of this technique claim that less incisional tenderness and earlier return of grip and pinch strengths permit the patient to return to work and ADL's earlier.<sup>7</sup> Studies have also demonstrated that "despite a relatively high incidence of incomplete release of the transverse carpal ligament, endoscopic techniques consistently increase the carpal canal volume in a manner similar to that reported for open carpal tunnel releases".<sup>7</sup> However, as this quote notes, there is some question concerning this technique. "Cadaveric endoscopic release studies and clinical case reports of endoscopic releases cite significant risks to and documented injuries of the median nerve, the deep motor branch of the ulnar nerve, the digital nerves, the superficial palmer arterial arch, the ulnar artery, and flexor tendons".<sup>7</sup> Endoscopic techniques have also had incidences of incomplete releases, as the surgeon is unable to visualize the ligament during this technique.

Miniopen techniques using small incisions placed away from the midpalm have been developed for carpal tunnel release. Miniopen carpal tunnel release can be performed with a smaller palmer incision and a specially designed cutting guide. The proponents of these techniques claim that the small incisions lessen postoperative palmer pain but still afford the necessary visualization to minimize neurovascular injury and incomplete ligament release.<sup>7</sup>

### **Examination:**

### **Medical History:**

The clinician should carefully review a patient's medical history questionnaire (on an ambulatory evaluation), patient's medical record including the patient's recent surgical report, found in the hospital's computerized medical record. Careful consideration should be made to identify any traumatic history to the affected extremity, rheumatoid illnesses, diabetes or other metabolic disorders.

### **History of Present Illness:**

The importance of obtaining a clear understanding of the patient's surgical intervention should not be underestimated. A careful and detailed report of the surgery is very revealing and can be

## **Standard of Care: Carpal Tunnel Release**

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very useful in estimating a patient's therapeutic needs and timeline for return of function to the affected hand. A patient's surgical report will describe the type of carpal tunnel release technique utilized, and how long post operatively the patient is presenting for therapy. A clinician should review any diagnostic testing results, or imaging also found in the computerized record.

The clinician should obtain information on the preoperative timeline concerning the onset and duration of carpal tunnel syndrome symptoms. The clinician should identify with the patient any provocative vs. relieving activities, and other behavior of the symptoms. Finally, the clinician should review any diagnostic tests and work-ups. Especially helpful would be reports from electromyographic testing if available. This test would note the presence and severity of nerve compression. Preoperative deficits and the severity of nerve damage should be understood, as this will effect current limitations and therapeutic outcomes.

If the patient is unable to provide a full history due to language barrier, then the clinician should utilize interpreter services.

### **Medications:**

The patient may be on NSAIDS (nonsteroidal anti-inflammatory drugs), as they are the medication of choice for decreasing inflammation, and soft tissue swelling leading to nerve compression. Corticosteroids can be injected directly into the wrist by an MD, and are provided to relieve pressure on the median nerve. This will usually provide immediate, temporary relief to persons with mild or intermittent symptoms.

### **Social History:**

Review of a patient's home, work, recreational activities. Information should be obtained on patient's prior functional and present functional levels on these tasks. A clinician should identify repetitive and/or resistive motions involving the wrist, as well as digital flexion and extension during a patient's daily activities. It is also of important to identify poor body mechanics and posture present during daily activities.

### **Examination** (Physical / Cognitive / applicable tests and measures / other)

This section is intended to capture the minimum data set and identify specific circumstance(s) that might require additional tests and measures.

### **Physical Examination**

**Active and Passive Range of Motion: (A/PROM):** Measure distal bilateral (B) upper extremity (UE) range of motion, (Elbow, forearm, wrist, thumb, digits) noting limitations to

### **Standard of Care: Carpal Tunnel Release**

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range due to pain, and or onset of paresthesias. Of note, for most mild to moderate CTS patients, A/PROM is expected to be within normal ranges. As the compression progresses, intrinsic muscles, such as the abductor pollicis brevis, flexor pollicis brevis, the opponens pollicis, and the adductor pollicis may weaken to the point that thumb opposition declines.<sup>5</sup>

**Edema:** To note for objective differences in widths, measurements should be taken to distal B UE. Widths to be measured on documented landmarks, usually the distal wrist and distal palmar creases, and recorded as circumferential measurements, in centimeters. In the absence of gross deformities, increases in width may show increased edema to carpal location and increase probability of median nerve compression.

**MMT/Strength testing:** Specific MMT for the abductor pollicis brevis, which is the most radial and superficial of the thenar muscles, is usually completed on evaluation. This muscle is the first to atrophy with median nerve dysfunction, such as that resulting from long-standing CTS.<sup>5</sup> The abductor pollicis brevis can be tested by having the patient perform palmar abduction while the examiner palpates the muscle. Thumb opposition strength can also be tested by having the patient demonstrate the “OK” position of thumb and index finger, then attempt to spread the thumb and index apart with your fingers in-between.

Strength testing for general grip and pinch strengths can be done by the use of a calibrated dynamometer and a calibrated pinch gauge. Both tests are completed by having the patient squeeze and/or pinch as hard as possible, alternating between hands, and taking the average from three trials. The pinch gauge can measure 3 point as well as lateral pinches. In most cases of mild to moderate CTS the effected hand will demonstrate lowered scores than the non-affected hand.

**Sensation:** A patient with CTS may demonstrate decreased sensation in the median nerve distribution of the hand. The severity of diminished sensation, or if there is a decline at all, is not a definite indicator of CTS, and can only contribute to the over all clinical presentation. A Semmes-Weinstein monofilament test is an accurate and objectively measurable test for sensory deficits in the hand. The Semmes-Weinstein can be a predictor of the quality of neural return, or the severity of diminution.<sup>6</sup> Please refer to the Sensation SOC for a description, and instructions for the administration of the test

**Pain:** As measured on the VAS (Visual Analog Scale). Specify location of pain, activities that increase pain and/or decreased pain.

1. Pain – Place
2. Amount – Pain level VAS (0-10)
3. Intensifiers

## **Standard of Care: Carpal Tunnel Release**

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4. Nullifiers
5. Effect on Function
6. Descriptors (i.e. sharp, dull, constant, throbbing, etc.)

**Functional Assessment:** The use of a specific functional capacity questionnaire is recommended to establish current functional deficits, assist in establishing goals, and to track progress.

Possible tools:

- Michigan Hand Questionnaire
- Manual Ability Measure

**Special Tests:** The two best-known provocative tests used in a CTS diagnosis are Phalen's sign and Tinel's sign.

- Phalen's sign; Also called the wrist-flexion test, the test is performed by having the patient drop both wrists into flexion, fingers and thumbs extended for 60 seconds. A positive sign includes numbness and paresthesias in the median nerve distribution within 60 seconds of sustained flexion.<sup>7</sup>
- Tinel's sign: The Tinel's test is performed with a light percussion of the Median nerve at the wrist. A positive Tinel's sign includes tingling and paresthesias over the median nerve distribution.<sup>7</sup>

**Acute (Inpatient (if applicable):**

As Above

**Sub-Acute (Outpatient) (if applicable):**

As Above

**Differential Diagnosis (if applicable):**

While CTS is certainly the most common of the neuropathies to occur in the upper extremity, it is important to note other common compression neuropathies that can at times mimic CTS.

**Standard of Care: Carpal Tunnel Release**

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- **C6 RADICULOPATHY:** C6 Radiculopathy caused by cervical spondylosis most commonly occurs in middle-aged or elderly patients and is the root with the greatest degree of nearly identical symptoms to those of median nerve compression.<sup>3</sup> Common symptoms associated with C6 radiculopathy, that do not occur in CTS include: Neck and shoulder pain, especially when they occur with concurrent coughing or sneezing. Similarly, back pain, located at the medial border of the scapula is characteristic of a radiculopathy, and is not expected in CTS. Night pain, a common complaint of a patient with CTS, does not occur with a patient suffering from radiculopathy, daytime pain with arm use is the usual complaint. If the sixth cervical nerve is affected, there may be weakness of elbow flexion and wrist extension, the biceps reflex may be lost or reduced, and electromyographic (EMG) studies will show denervation out of median nerve territory if the cause of the disorder is cervical nerve root damage.<sup>3</sup> Finally, utilizing the Semmes-Weinstein sensory test, the clinician would note a sensory loss of the C6 dermatome (thumb and lateral boarder of the upper extremity running to the neck), rather than the expected loss at the thumb, index, middle and radial half of the 4<sup>th</sup> digit. For further information regarding C6 radiculopathy, please refer to the radiculopathy standard of care.
- **PRONATOR SYNDROME:** Also a syndrome resulting from a compression of the medial nerve, the differences in symptoms are due in part to the site of compression. In pronator syndrome, the medial nerve becomes compressed as it passes by the pronator muscle, and the insertion of the deep flexor muscles at the elbow joint. With this syndrome, sensory loss will mimic that of CTS, however, there are several differences between the two diagnoses. The pronator syndrome is distinguished by exacerbation attributable to resisted pronation and passive supination activities, positive Tinel's sign at the proximal forearm overlying the median nerve, tenderness and paresthasias in the median nerve distribution on direct compression over pronator muscle, and pain and median nerve paresthasias with forced pronation, as well as passive supination at the limit of full elbow extension.<sup>3</sup> Symptoms brought on by wrist movements, a hallmark of CTS are not common with pronator syndrome.
- **RAYNAUD'S DISEASE:** The symptoms caused by local vasospasm are differentiated from CTS in the sense that Raynaud's phenomenon does not involve any distinction between the fingers, with all the fingers and palm being equally affected.<sup>3</sup> Diminished circulation symptoms such as color blanching at the digits, and cool to the touch temperature of the hand can be observed on a patient with Raynaud's, while they are not observed in patients with CTS.
- **CUBITAL TUNNEL SYNDROME:** Cubital tunnel syndrome is an ulnar nerve compression neuropathy resulting from acute or chronic external pressure on the ulnar

### **Standard of Care: Carpal Tunnel Release**



nerve as it passes through the cubital tunnel during its course from the arm to the forearm.<sup>8</sup> The cubital tunnel is formed by the condylar groove between the medial epicondyle of the humerus and the olecranon of the ulna.<sup>8</sup> The symptoms of ulnar nerve compression will be quite different from ones caused by median nerve compression. Patients will usually describe a sharp or aching pain on the medial side the elbow, hand pain is not as common as it is in CTS. Sensory loss will be felt at the ring and small fingers, motor loss will be seen by atrophy of the 3<sup>rd</sup> and 4<sup>th</sup> lumbrical muscles. A more recognizable clinical feature is atrophy of the intrinsic muscles with clawing of the ring and little fingers.<sup>8</sup> Special testing for cubital tunnel would include:

1. Tinel's sign: The Tinel's test is performed with a light percussion of the ulnar nerve at the cubital tunnel. A positive Tinel's sign includes tingling and paresthesias over the ulnar nerve distribution.
2. Elbow flexion test of Wadsworth:<sup>8</sup> This test is performed by having the patient hold elbows in full flexion, with wrists held in extension. This position will increase pressures within the cubital canal. A positive test includes tingling and paresthesias over the ulnar nerve distribution. For further information regarding cubital tunnel syndrome, please refer to the cubital tunnel syndrome standard of care.

### **Evaluation / Assessment:**

### **Establish Diagnosis and Need for Skilled Services**

Patients diagnosed with CTS will benefit from conservative treatment with therapy to assist in minimizing impairments, improving functional status, and reduce the need for surgical intervention. Patients following a CTR will require skilled therapeutic interventions for a variety of postoperative issues.

Potential Problem List (Identify Impairment(s) and/ or dysfunction(s)):

- Pain to affective hand  
**Palmer Pain:** Postoperative pain, located at the site of decompression can be expected with most CTR. Post operative palmer pain may contribute to delayed return to work, particularly among manual laborers or workers with repetitive motion tasks. Palmer pain has been described after all techniques of carpal tunnel release, whether open. Miniopen or endoscopic, and may be a significant impediment to patient's recovery.<sup>14</sup>

### **Standard of Care: Carpal Tunnel Release**

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**Pillar Pain:** Pillar pain is localized to the thenar or hyperthenar areas and is to be distinguished from palmar incisional pain or scar tenderness.<sup>14</sup> Although the exact cause of pillar pain is not known, it has been suggested that sectioning the transverse carpal ligament alters the ligaments/intrinsic muscles of the hand. These changes of the muscles, or the edges of the cut ligament may be the causes of the pain. Povlsen and Tegnell found that 41% of patients experience pain at 1 month after surgery, 25% at 3 months, and 6% at 12 months.<sup>14</sup>

- Paresthesias: numbness and/or tingling, which can impair the patient's fine motor control of affected digits
- Declined grip and/or pinch strength to affected hand
- Post operative edema to affected hand
- Post operative hypertrophic scarring and scar adhesions to the median nerve
- Post operative infections
- Adhesions with decreased glide of the flexor tendons traveling in the carpal tunnel
- Declined distal AROM of the involved extremity
- Declined endurance of affected hand for repetitive activity
- Declined functional use of affected hand for ADL tasks
- Declined knowledge of ergonomic education, proper body mechanics and joint protection during ADL's, and in the work environment

### **Prognosis**

Clinical practice suggests that patients will have different outcomes in terms of pain relief and sensory return, strength and function. For the purposes of this standard, relevant clinical improvement is defined as significant relief of pain and paraesthesia by at least 50% of the baseline level, or the improvement of muscle weakness resulting in improvement in quality of life and functional status.<sup>9</sup> Open decompression of the median nerve has stood the test of time with a number of retrospective studies documenting patient satisfaction and symptom improvement ranging from 86% to 96%.<sup>14</sup> Brown et al performed a prospective, randomized study of two-portal endoscopic and open carpal tunnel release in 169 hands with clinical and electrodiagnostic CTS that had not responded to conservative treatment (non-operative). At the end of the follow up period, both the open and endoscopic groups had equally high levels of patient satisfaction with relief of pain and paresthesias.<sup>14</sup> It is difficult to make definitive conclusions about the outcomes of surgical interventions for CTR due to variations in outcome measures, the severity of preoperative CTS and inconsistencies in duration, type of intervention, and follow-up time for interventions.<sup>10</sup> It is of interest to note, that the conclusions to multiple studies into the effects of conservative interventions, all tend to lead to the conclusion that surgical treatment of CTS relieves symptoms better than conservative interventions on patients

### **Standard of Care: Carpal Tunnel Release**

with overt symptoms.<sup>9</sup> While no time line for rehabilitation is set in stone, the resolution of symptoms and the return of functional use of affected extremity follows a course of early nocturnal palmer pain, hand weakness and tingling that generally improves within 6 weeks after surgery.<sup>14</sup>

### **Goals**

- Goals will be measurable and reassessed every 30 days
- Goals will reflect individual patient's functional impairments in ADL's, leisure and/or work tasks
- Goals will include patient's ability to follow home program
- Goals will be to eliminate potential post operative problems a patient might demonstrate, as listed above
- Goals to reflect patient's education of body mechanics and ergonomics, including the avoidance of provoking postures and activities.
- If splinting is involved in the treatment program, goals will reflect the patient's independence in their wearing schedule, and the care and hygiene of splints.

### **Age / Other Specific Considerations**

As previously described, women, especially between the ages of 40-60, are most likely to develop CTS. Therapists who are treating this patient population should consider degenerative joint diseases and other medical issues associated with aging.

Women who are pregnant are also at a higher risk for developing CTS. When treating this population, therapist should consider not only medical issues associated with pregnancy, but also specific life tasks such as child care. Breast feeding, lifting and/or carrying a newborn may place the affected upper extremity in provoking postures, and adaptations to these activities may be necessary.

The other large populations are adult workers whose occupations require repeated overuse activities should be considered. Occupational variants predisposing CTS may include carpentry, secretarial work, auto mechanics and construction workers.<sup>11</sup> Treatment with this population should include assessments and adaptations of such activities that place the extremity at risk for nerve entrapment at the wrist.

### **Treatment Planning / Interventions**

Established Pathway

Yes, see attached.

No

11

### **Standard of Care: Carpal Tunnel Release**

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Established Protocol

Yes, see attached.

No

## **Interventions**

*This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.*

**Splinting:** Post operatively, splinting of the wrist in the neutral position to 15 deg of extension will minimize discomfort.. Splinting the wrist in this position, places the carpal tunnel in its most open position, allowing for restoration of maximal circulation to the median nerve. Further compression to the median nerve with prolonged wrist flexion while sleeping, or during daily/occupational activities are prevented with the use of a wrist splint. <sup>10</sup>Typically pre-fabricated Velcro closed wrist splints are used. The occupational or physical therapist for the patient that is receiving therapy services typically fits this. (Please note: Patients with CTS may be referred for only a prefabricated splint for the management of their CTS. In this case the prefabricated splint is fit and applied by an orthopedic technician upon receipt of the prescription from the MD. Please refer to the prefabricated wrist splint standard of care for specific details.)

Most patients will not require postoperative splinting, however this decision should be looked at on a case-by-case basis. Splint wearing is primarily recommended for patients who experience nighttime pain associated with flexed postures of the wrist, and can also be used to provide rest to persistently inflamed tissues. Patients who are having complaints of constant symptoms, or who have pain and or sensory changes with activity are instructed to wear the splint at work or during highly resistive and repetitive motions. The patient is generally instructed to continue with the splint-wearing schedule for 4 to 6 weeks, and then gradually decrease splint use over the subsequent 4 weeks.

If a patient is unable to comfortably fit into a pre- fabricated splint, or if the correct wrist position cannot be achieved due to wrist deformity, or unusual wrist size, a custom orthoplast splint may be fabricated. Either an occupational therapist or physical therapist fabricates this custom splint for the patient. As with the pre-fabricated splint, the wrist should be placed in the neutral to 15 deg of extension position. If a patient's symptoms do not positively respond to basic wrist splinting, recent studies have shown a benefit to extending the orthoplast splint distally to include the patient's metacarpophalangeal joints (MCP's) in extension. This splint immobilizes the MCP's and does not allow for the lumbrical muscles (intrinsic hand muscles responsible for MCP flexion) to rest within the tunnel. <sup>14</sup> The splint-wearing schedule for this splint would mimic the schedule for the wrist splint; however, the patient should be instructed to remove this splint periodically throughout the day for mobilization of the MCP's, and tendon gliding exercises (see below) to eliminate the possibility of creating joint stiffness.

## **Standard of Care: Carpal Tunnel Release**

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**Scar Management:** Postoperative management of the scar should begin once the surgical steri-strips have fallen off the surgical site. The incision should be without dehiscence, or discharge. Light scar massage can be initiated 2-3 days after the sutures have been removed, gradually becoming more vigorous as tolerated. Scar pads should be provided to provide compression that will minimize edema and scar tissue formation, achieving softer, pliable scar tissue. Simultaneously, a program of desensitization with graded textures is also initiated to minimize scar discomfort.

**Edema Control:** Treatment for edema consists of compression (coban wrap, tubi-grip sleeve), elevation, icing and mobilization of the digits to stimulate venous and lymphatic flow. (Hayes) Patients should be educated on the importance of maintaining the elevated position during the initial rehabilitation phase, as hands are frequently held in the dependent position.

**Ergonomic education:** Repetitiveness of work tasks, and poor posture during repetitive tasks are commonly cited risk factors for the development of CTS, and poor results following CTR.<sup>14</sup> As discussed above, during the assessment of these patients, occupational tasks and the patient's posture during these activities should be identified. On going education should include avoidance of wrist postures (i.e., prolonged wrist flexion), repetitive wrist motions such as gripping or pinching objects while flexing the wrist, and performing repetitive wrist flexion-extension exercise motions.<sup>14</sup> It is important to evaluate the work environment and to suggest alternatives such as ergonomically designed workstations designed to limit postural stresses.

**Mobilization:** Patients are to begin immediately post operatively the active motion of the thumb, digits and wrist to prevent joint stiffness, ensure adequate glide of the tendons and median nerve in the carpal tunnel. Mobilization will also aid during the initial scar formation. Exercises of the distal extremity should be completed 7-10 repetitions, and are completed 3-5 times daily.<sup>14</sup> Wrist ROM is initially completed with the digits relaxed during flexion to minimize the compressive forces on the median nerve.<sup>14</sup> PROM should be initiated at least 4 weeks post operatively, and utilized only for mobilization of stiff joints, and elongate shortened tendons.

**Tendon-Gliding exercises:** Isolated tendon gliding exercises of the flexor digitorum superficialis and flexor digitorum profundus to each digit passing through the carpal tunnel has also shown to be effective in recent studies. The results of the study indicated a significant improvement in patients' carpal tunnel symptoms when tendon-gliding exercises were performed in conjunction with traditional treatment.<sup>14</sup> Each exercise series starts with the wrist and digits in full extension, then the digits are held in a hook grip, followed by a straight fist, followed by a full fist. These exercises are to be performed five times each, five times daily.<sup>14</sup>

## **Standard of Care: Carpal Tunnel Release**

**Modalities:** The use of ultrasound for elevating pain thresholds and achieving scar modification (when followed by AROM and stretching) are well established. <sup>14</sup> However, “ultrasound use after carpal tunnel release should be approached with caution because the ramifications of its use over a regenerating nerve are not clearly understood”. <sup>14</sup>

**Strengthening:** Strengthening is initiated at 3-4 weeks as wounds heal and inflammation resolves. Strengthening program should be specific to the strength deficits noted on the initial evaluation, such as thenar weakness, grip strength, and overall UE conditioning. More intensive strengthening, or work hardening program can begin 4 weeks post operatively, and completed as tolerated by the patient.

### **Frequency & Duration**

- Frequency of hand therapy for CTR is 1-2x/wk for 8 weeks, or as indicated by patients' status and progression. Progression and improvement will be indicated by the achievement of established short-term goals, and the elimination of symptoms per patient reports and subjective testing.
- Duration of each treatment session is dictated by the patient's needs.

### **Patient / Family Education**

- Instruction of home program with verbal and written instructions.
- Ergonomics, body mechanics, adaptive equipment and adaptations as needed during ADL's.
- Splint don/doff, wearing schedule and hygiene.
- Education on CTS, basic anatomy and causes of compression.

### **Recommendations and Referrals to Other Providers**

- Pt will be referred back to attending physician surgeon should symptoms persist or worsen.

### **Re-evaluation / assessment**

#### Standard Time Frame

- Goals will be reassessed every 30 days

#### Other Possible Triggers

- A significant change in symptoms that has reduced patient's baseline functional level

### **Standard of Care: Carpal Tunnel Release**

- Discharge from therapy program

### **Discharge Planning**

Discharge planning begins at the initial evaluation of the patients as the treatment plan, prognosis and frequency are initiated.

### **Commonly Expected Outcomes at Discharge**

- Patient upon discharge from therapy should be independent with home program and have returned to there premorbid level of function.
- Patient should demonstrate independence with adaptations and adaptive equipment during ADL's.
- Patient should report resolution of paresthesias and/or pain to affected hand.

### **Transfer of Care (if applicable)**

Should symptoms persist and/or increase, pt to be referred back to patients PCP or specialist who referred patient to therapy.

### References:

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### **Standard of Care: Carpal Tunnel Release**

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