Diagnosis of True Recurrent Carpal Tunnel Syndrome

19

Bilal Mahmood and Warren C. Hammert

Recurrence of carpal tunnel syndrome is a challenging condition, often requiring additional surgery and in some cases, prolonged treatment for pain management. Carpal tunnel syndrome (CTS) is the most common compressive neuropathy in the upper extremity and clinical practice guidelines for diagnosis exist through the American Academy of Orthopaedic Surgeons [1]. These are currently being updated, with anticipated publication of new guidelines in 2016. Most of the time, treatment is successful with carpal tunnel release and patients experience permanent relief of symptoms. Occasionally, a patient will have a recurrence of symptoms, but this is not common and there are no evidence-based guidelines for diagnosis or treatment of recurrent carpal tunnel syndrome. Studies suggest that complications and failures of carpal tunnel release occur in 3% to 25% of cases and reoperation is performed in less than 5% of cases [2–5].

It is important to differentiate recurrence from persistent symptoms. Specifically, recurrence occurs following a symptom-free period of time following surgical decompression [6]. This is often defined as a 6-month interval, but there is no definitive evidence to set this time point. For the purposes of this discussion, we exclude recurrence of symptoms that may occur following nonoperative treatment, even if there is a symptom-free interval. In these cases, initial decompression surgery is the next step.

The pathophysiology of recurrent carpal tunnel syndrome is challenging to confirm. Postoperative perineural fibrosis is thought to contribute to recurrence, causing traction at specific points along the course of the median nerve or direct compression due to circumferential fibrosis [7–11]. The incidence of constriction of the median nerve during revision surgery is reported as 23–100% [2, 10]. If recurrence occurs several years following the index procedure, the cause is attributed to increased pressure in the carpal tunnel, which may be due to degenerative conditions leading to changes in the shape of the wrist. The challenge in the above explanations of recurrent carpal tunnel syndrome remains that there are no prospective studies to define the normal appearance of a completely released

B. Mahmood
Department of Orthopaedics and Rehabilitation, University of Rochester Medical Center, 601 Elmwood Ave., Box 665, Rochester, NY 14612, USA

W.C. Hammert (✉)
Department of Orthopaedics and Rehabilitation, University of Rochester Medical Center, 601 Elmwood Ave., Box 665, Rochester, NY 14612, USA

Division of Hand Surgery, Department of Orthopaedics and Rehabilitation, University of Rochester Medical Center, Rochester, NY, USA
e-mail: Warren_Hammert@URMC.Rochester.edu

S.F.M. Duncan, R. Kakinoki (eds.), *Carpal Tunnel Syndrome and Related Median Neuropathies*, DOI 10.1007/978-3-319-57010-5_19

Table 19.1 History and physical exam findings with persistent, recurrent, and new symptoms following carpal tunnel release

History	Exam	Symptoms	Potential causes
Paresthesias in the median nerve distribution unchanged following surgery	+ Provocative tests unchanged following surgery, ± thenar atrophy	Persistent	Incomplete release of the transverse carpal ligament
Paresthesias in the median nerve distribution improved following surgery prior to returning	+ Provocative tests returning following symptom-free interval following surgery, ± thenar atrophy	Recurrent	Perineural fibrosis or reconstitution of the transverse carpal ligament
Paresthesias not present prior to surgery, increased intensity of pain following surgery, new onset weakness	Tinel sign at new injury site, ± provocative tests	New	Iatrogenic nerve injury, complex regional pain syndrome

Adapted from Mosier and Hughes [11]

transverse carpal ligament or what a normal amount of fibrosis may be [6]. Such studies are difficult to perform given most patients have good relief of symptoms following surgery and do not need additional studies [6].

Persistence of symptoms may occur following an incomplete release or an error in diagnosis resulting in the incorrect surgery. In these cases the patient does not experience any relief after surgery [11]. New symptoms may also develop that are different than preoperative symptoms. Even with a symptom-free interval, a variety of possibilities exist that can cause symptoms that are grouped into a diagnosis of recurrent carpal tunnel syndrome. Table 19.1, adapted from Mosier and Hughes [11], summarizes persistent, recurrent, and new symptoms. In this chapter, we introduce an appropriate workup to diagnose true recurrent carpal tunnel syndrome.

Clinical Presentation

The diagnosis of recurrent carpal tunnel syndrome begins with a thorough history, attempting to document symptoms prior to primary carpal tunnel decompression, including details such as nighttime awakening, daytime numbness, whether the numbness was intermittent or constant, and whether the initial symptoms were confined to the median nerve distribution [12, 13]. Pain should be differentiated from numbness, as many patients perceive all wrist or hand pain to be synonymous with carpal tunnel syndrome. In addition, any preoperative electrodiagnostic studies should be obtained. In summary, the anatomic distribution of symptoms, specific symptoms, and exacerbating and alleviating factors if any are all important aspects of the history that will help in diagnosing recurrence.

Following the establishment of the clinical picture prior to the initial diagnosis of carpal tunnel syndrome, one must elicit the patient's description of events surrounding decompression and the return of symptoms. It is important to determine if any symptoms improved or resolved, if any symptoms worsened, and the timing of these. The goal is to determine whether the patient has persistent, recurrent, or new symptoms [11]. An improvement in position-specific symptoms, improvement in paresthesias, or improvement in intermittent pain all point toward a complete release of the transverse carpal ligament. If the same symptoms return after a symptom-free interval, true recurrence is likely. Persistent numbness may be due to chronic compression and does not always improve following complete release of the ligament. One may consider baseline Semmes-Weinstein testing to observe improvement over time [14]. If intermittent symptoms worsen or new symptoms develop immediately following surgery, one has to consider iatrogenic nerve injury. No change in intermittent symptoms may cause one to consider an incomplete release. Of note, at least one study in the literature has found hypertension and

diabetes to be associated with recurrence of carpal tunnel syndrome [15]. Thus, one should still take a full history, including a complete past medical history, family, and social history. Amyloidosis and inflammatory disorders can also cause proliferative tenosynovitis and contribute to symptoms for which a patient is seeking revision carpal tunnel surgery [2].

Another important reason for a detailed history is to determine whether the initial diagnosis of carpal tunnel syndrome was correct. It is possible that a patient presenting with a wide variety of hand and wrist complaints is diagnosed with carpal tunnel syndrome. Conditions such as ulnar neuropathy, basal joint arthritis, or compression of the median nerve proximal to the carpal tunnel are all conditions that may coexist or be mistakenly diagnosed as carpal tunnel syndrome. In addition, the patient may have electrical studies that indicate median nerve compression at the carpal tunnel, but clinical symptoms that are not typical for CTS and do not respond to carpal tunnel release.

Physical Examination

The physical examination should be thorough and include the entire upper extremity, evaluating for other common conditions that may coexist with CTS. In addition, other areas of nerve compression must be ruled out, including compression proximally such as with pronator syndrome and even cervical spine pathology. The exam begins with inspection and comparison to the contralateral limb, beginning at the hand and working proximally. Skin color and any warmth or erythema is noted. Thenar strength is evaluated, noting any atrophy that may be present. The prior incision is also inspected and then palpated. Tenderness anywhere along the incision site is noted as well as tapping on the nerve to illicit a Tinel sign.

The sensory exam is of particular importance. This consists of light touch and two-point discrimination. Decreased two-point discrimination can be a late finding in median nerve compression and may still be present following a complete carpal tunnel release. Similarly, a change in threshold with Semmes-Weinstein monofilament may be present in chronic nerve compression even after complete release. However, this information is useful in comparing the bilateral upper extremities as well as having a comparison to the exam prior to initial release if these data were obtained. When checking two-point discrimination, it is important to be oriented in a longitudinal direction to prevent measurement of the adjacent digital nerve [16].

Motor function of the intrinsic muscles is important in the physical examination for carpal tunnel syndrome. Opposition of the thumb to the little finger is used to test thenar muscle function and median nerve innervation. When testing opposition and strength, one should note that the deep head of the flexor pollicis brevis (innervated by the ulnar nerve) and the flexor pollicis longus can flex the thumb across the palm to the little finger [16].

Specific provocative maneuvers for median nerve compression should be performed in a complete examination of the hand. In cases of compression elsewhere, such as with pronator syndrome, a Tinel sign will be absent over the transverse carpal ligament but present in the proximal anterior forearm. In the event there is compression of the nerve in the distal forearm, possibly from incomplete release of the antebrachial fascia, the patient may have symptoms when tapping on the nerve in this region. If an iatrogenic injury to a branch of the median nerve is being considered, percussion five to eight centimeters proximal to the incision site may lead to the patient localizing paresthesias along the course of the injured nerve [17]. When done over the site of injury, the pain may be too much for the patient to localize. Provocative maneuvers for median nerve compression include the carpal tunnel compression test (Durkan's test), performed by applying manual compression over the transverse carpal ligament for 30 s. Tinel sign and the carpal tunnel compression test are both positive when paresthesias are elicited along median nerve innervation. Phalen and reverse Phalen are performed by maximal flexion (Phalen), and extension (reverse Phalen), held for 60 s to illicit numbness in the median nerve distribution [16].

A thorough physical examination as described above is performed not only for current symptoms but as a comparison for prior symptoms. It further guides the clinician toward recurrent, persistent, or new symptoms and adds to information obtained in the history. For example, thenar atrophy confirms the likelihood of chronic compression of the median nerve. A lack of change in symptoms combined without improvement symptoms post-surgery points toward an incomplete release of the transverse carpal ligament causes persistent symptoms. Pain along the third web space with percussion proximal to the incision site may indicate entrapment or iatrogenic injury of the superficial branch coming off the median nerve to the third web space [17]. Most importantly, comparison of physical exams prior to and post initial carpal tunnel release may provide notable information with regard to the presences of a symptom-free interval or an iatrogenic injury.

Diagnostic Studies

A thorough history and physical exam can lead to the correct diagnosis when considering recurrent CTS and also rule out persistent symptoms, new iatrogenic nerve injury, or an error in initial diagnosis. When recurrent carpal tunnel syndrome is strongly suspected, further studies can be confirmatory, and when the clinical picture is still vague, further studies can provide valuable information in leading one to the correct diagnosis.

Electrodiagnostic studies are often a part of a carpal tunnel syndrome workup. The AAOS guidelines state that they are a good practice in workup and, although they may not be necessary to establish the diagnosis, should be ordered for patients undergoing surgery. For the diagnosis of carpal tunnel syndrome, a distal motor latency greater than 4.5 ms or distal sensory latency greater than 3.5 ms is often considered abnormal [13]. Chronic cases may show electromyography changes with increased insertional activity, fasciculations, and fibrillations of the abductor pollicis brevis. Utilization of electrodiagnostic studies is less clear in the workup for recurrent carpal tunnel syndrome. In cases where no preoperative studies were performed prior to initial carpal tunnel release, new studies may not be helpful. Studies have shown post carpal tunnel release nerve conduction velocities to be increased and not necessarily correlated with outcomes [12, 18]. In addition, there is no evidence to suggest electrical studies return to normal following carpal tunnel release, especially in more severe cases, so abnormal studies following carpal tunnel release can be difficult to interpret. However, in a patient already seeking treatment for continued symptoms, potentially with recurrent carpal tunnel syndrome or initial misdiagnosis, electrodiagnostic studies are valuable to obtain for future comparison even if they do not help with current diagnosis. When preoperative studies were performed, obtaining new studies are helpful. Improvement in electrodiagnostic studies, particularly nerve conduction velocities, indicates successful surgery and complete transverse carpal ligament release [11]. This may lead one away from a diagnosis of recurrent carpal tunnel syndrome when combined with other information from the history and physical examination. The literature varies with regard to worsening nerve conduction studies. Although Jones et al. in 2012 [2] recommended surgery when repeat nerve conduction studies are worse and there are signs of denervation of the thenar muscles, studies by Unglaub et al. [12] and Stutz et al. [18] from 2008 show post carpal tunnel release nerve conduction velocities to be increased for up to 24 months following carpal tunnel release. Thus, electrodiagnostic studies are a good adjunct when combined with a complete history and physical exam, but they need to be interpreted on a case-by-case basis in developing an accurate diagnosis of recurrent carpal tunnel syndrome.

A corticosteroid injection is often a useful nonsurgical management option in both primary and recurrent carpal tunnel syndrome. In primary carpal tunnel syndrome, it is known as a predictor of surgical success. Edgell et al. in 2003 [19] reported a surgical success rate of 87% in patients who had relief with a corticosteroid injection,

compared to 54% in patients who did not. Beck et al. [20] looked at predictive value of corticosteroid injection for recurrent carpal tunnel syndrome. The authors discovered similar rates when looking at surgical success rate in patients who had relief with a corticosteroid injection (87%) compared to those who did not (60%). However, this positive trend did not reach clinical significance. Using their data, the authors did note relief from injection as a diagnostic test for successful revision carpal tunnel release to have an 87% sensitivity, 87% positive predictive value, and 40% specificity.

Imaging

Radiographs are often a part of the initial visit in the office setting for any patient with wrist pathology. In the initial workup for carpal tunnel syndrome, radiographs are not required, and it is uncertain whether there is any merit to obtaining them due to the low likelihood of influencing the workup for a typical case of carpal tunnel syndrome [13]. Similarly, in the case of recurrent carpal tunnel syndrome, there are no data to suggest that wrist radiographs are necessary. In cases where a history of trauma produces the symptoms for which a patient is seeking medical attention, they may be obtained as per standard workup.

AAOS guidelines recommend against the use of MRI in the routine evaluation of patients with carpal tunnel syndrome. Similarly, no data exist to provide a framework for the use of MRI in working up recurrent carpal tunnel syndrome. However, it once again falls to a case-by-case basis, and it can be certainly helpful in defining pathologic anatomy that may or may not have been considered in a workup [11]. In 2006, Stutz et al. [10] reported on 200 revision carpal tunnel surgeries with intraoperative finding noting two ganglions, one lipoma, and one fibroma. This small group of findings could have been diagnosed via MRI prior to revision surgery and given the surgeon a definitive cause, but likely would not have changed treatment. A challenge in the interpretation of an MRI post carpal tunnel release is the lack of knowledge regarding the appearance of a released transverse carpal ligament and the normal amount and appearance of synovium [6]. Prospective studies to determine this would be expensive and difficult to perform without an agreed upon reference. However, obtaining an MRI remains an option to the clinician working up recurrent carpal tunnel syndrome if he or she has a specific question in mind that it can address.

Conclusion

Diagnosis of recurrent carpal tunnel syndrome is complex. One cannot take one piece of the history or an individual provocative maneuver during the physical exam as being predictive in terms of a correct diagnosis. However, used in combination, a thorough history, detailed physical examination, and appropriate diagnostic tests and imaging can be combined to give an accurate diagnosis. In 2012, Jones et al. [2] determined a positive Phalen test, weak abductor pollicis brevis compared to the contralateral side, and subjective splitting of ring finger sensation as the most important parts of the physical exam during the evaluation for recurrent carpal tunnel syndrome. Also in 2012, Beck et al. [20] used multivariate logistic regression analysis to determine numbness or weakness in the median nerve distribution, combined with a positive carpal tunnel compression test, positive Phalen test, and relief with corticosteroid injection provided a sensitivity of 100% and specificity of 80%.

Thus, a complete history and physical examination remain the foundation for the workup of recurrent carpal tunnel syndrome. Further tests are indicated based on information obtained by the clinician with a detailed history and appropriate examination. Electrodiagnostic studies should be pursued even when they are unlikely to help with the current workup, as they may be useful in the future. Radiographs or an MRI is used when specifically looking for pathology that one can diagnose based on images, although as normal post carpal tunnel release imaging is better defined, an MRI could be useful in evalu-

ating the amount of scar formation and volume in the carpal tunnel. Confidence in an accurate diagnosis is necessary as it dictates the appropriate treatment and optimizes the patients' chances for a successful outcome following revision treatment.

References

1. American Academy of Orthopaedic Surgeons Work Group Panel. Clinical guidelines on diagnosis of carpal tunnel syndrome. Available at: http://www.aaos.org/Research/guidelines/CTS_guideline.pdf. Accessed 14 Jun 2014.
2. Jones N, Ahn C, Eo S. Revision surgery for persistent and recurrent carpal tunnel syndrome and for failed carpal tunnel release. Plast Reconstr Surg. 2012;129:683–92.
3. Azbug J, Jacoby S, Osterman A. Surgical options for recalcitrant carpal tunnel syndrome with perineural fibrosis. J Hand Surg [Am]. 2012;7:23–9.
4. Cobb T, Amadio PC. Reoperation for carpal tunnel syndrome. Hand Clin. 1996;12:313–23.
5. Botte M, von Schroeder H, Abrams R, Gellman H. Recurrent carpal tunnel syndrome. Hand Clin. 1996;12:731–43.
6. Amadio PC. Interventions for recurrent/persistent carpal tunnel syndrome after carpal tunnel release. J Hand Surg [Am]. 2009;34:1320–2.
7. Tung T, Mackinnon S. Secondary carpal tunnel surgery. Plast Reconstr Surg. 2001;107:1830–43.
8. Mackinnon S. Secondary carpal tunnel surgery. Neurosurg Clin N Am. 1991;2:75–91.
9. Hunter J. Recurrent carpal tunnel syndrome, epineural fibrous fixation, and traction neuropathy. Hand Clin. 1991;7:491–504.
10. Stutz N, Gohritz A, Van Schoonhoven J. Revision surgery after carpal tunnel release-analysis of the pathology in 200 cases during a 2 year period. J Hand Surg (Br). 2006;31:68–71.
11. Mosier BA, Hughes TB. Recurrent carpal tunnel syndrome. Hand Clin. 2013;29:427–34.
12. Unglaub F, Wolf E, Goldbach C. Subjective and functional outcome after revision surgery in carpal tunnel syndrome. Arch Orthop Trauma Surg. 2008;128:931–6.
13. Cranford CS, Ho JY, Kalainov DM, Hartigan B. Carpal tunnel syndrome. J Am Acad Orthop Surg. 2007;15:537–48.
14. Steyers C. Recurrent carpal tunnel syndrome. Hand Clin. 2002;18:339–45.
15. Schreiber J, Foran M, Schreiber D. Common risk factors seen in secondary carpal tunnel surgery. Ann Plast Surg. 2005;55:262–5.
16. Kenney R, Hammert W. Physical examination of the hand. J Hand Surg Am. 2014;39:2324–34.
17. Mackinnon S, Novak C. Compression neuropathies. In: Wolfe SW, editor. Green's operative hand surgery. 6th ed: Elsevier; 2010. p. 975–1014.
18. Stutz N, Gohritz A, Novotny A. Clinical and electrophysiological comparison of different methods of soft tissue coverage of the median nerve in recurrent carpal tunnel syndrome. Neurosurgery. 2008;62:194–8.
19. Edgell S, McCabe S, Breidenbach W, LaJoie A, Abell T. Predicting the outcome of carpal tunnel release. J Hand Surg [Am]. 2003;28:255–61.
20. Beck JD, Brothers JG, Maloney PJ, Deegan JH, Tang X, Klena JC. Predicting the outcome of revision carpal tunnel release. J Hand Surg [Am]. 2012;37:282–7.