Diagnosis

The classic history is of the patient who begins his or her symptoms by awakening at night with numbness and pain in the median nerve distribution of his or her hand(s). This progresses to daytime symptoms that are often aggravated by activities.1,2 The occurrence of “dropping objects” in carpal tunnel syndrome patients is an index of elevated disease severity.3 Carpal tunnel symptoms in pregnancy persist in more than 50 percent of the patients after 1 year and in approximately 30 percent after 3 years.4

The highest sensitivity and specificity on physical examination are found with the wrist flexion-carpal compression examination (82 and 99 percent, respectively) (Fig. 1) and the Durkan carpal compression test (87 and 90 percent, respectively) (Fig. 2).5 In a study comparing the scratch collapse test, the Tinel test, and the wrist flexion/compression test in carpal tunnel syndrome, sensitivities were 64, 32, and 44 percent, respectively (Level of Evidence: Diagnostic, II).6

The scratch collapse test had the highest negative predictive value (73 percent) for carpal tunnel syndrome. The scratch collapse test had significantly higher sensitivity than the Tinel test and the flexion/nerve compression test.

Nerve conduction studies have a sensitivity ranging from 73 to 100 percent but a specificity of 97.5 percent.7 A recent review comparing nerve conduction studies with ultrasound, computed tomography, and magnetic resonance imaging concluded that the nerve conduction study remains the criterion standard8 preoperative investigation. However, a negative nerve conduction study does not mean a patient does not have carpal tunnel syndrome that will respond to surgery. Concannon et al. retrospectively reviewed a large series of patients who responded to surgery
in spite of the fact that 13 percent of them had negative nerve conduction studies.9

**Splinting**

Preoperative splinting and exercise improve carpal tunnel symptoms.10 Magnetic resonance imaging studies have shown that intraneural edema reduction is a likely therapeutic mechanism of splinting and exercise.11

**Steroid Injections**

Ly-Pen et al. compared surgical carpal tunnel release to local steroid injection in 163 wrists with carpal tunnel syndrome. At a 2-year follow-up, 60 percent of the wrists in the injection group versus 69 percent in the surgery group reached a 20 percent response for nocturnal paraesthesias (Level of Evidence: Therapeutic, II).12 Patients with an electrodiagnostically mild carpal tunnel syndrome are good candidates for a local steroid injection, with 50 percent having a good long-term effect for more than 15 months.13 A 2005 study compared steroid injection to open carpal tunnel release. The latter resulted in better symptomatic and neurophysiologic outcome but not grip strength in patients with idiopathic carpal tunnel syndrome over a 20-week period.14 A 2008 Cochrane review of steroid versus surgery revealed that surgical treatment of carpal tunnel syndrome relieves symptoms significantly better than splinting.15

**Alternative Treatments**

Phonophoresis is the use of ultrasound to enhance the delivery of topically applied drugs. This method of delivery of steroidal and nonsteroidal antiinflammatory drugs to the carpal tunnel can provide relief.16 Shortwave hyperthermia17 and massage18 may be helpful.

Acupuncture was not superior to placebo acupuncture when used in conjunction with splinting for patients with mild to moderate carpal tunnel syndrome.19 Low-level laser20 and gabapentin21 are also not beneficial (Levels of Evidence: Reference 20: Therapeutic, II; Reference 21: Therapeutic, I). A 2013 Cochrane study concluded 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 (Level of Evidence: Therapeutic, II).22

**EVIDENCE IN ANESTHESIA**

It is likely that the most significant change in carpal tunnel release in the past few years has been in the anesthesia used for the operation. The rapid widespread adoption of ultrasound guidance has certainly improved the proximal block ability of anesthesiologists to provide tourniquet anesthesia.23 In contrast, the majority of Canadian hand surgeons now use adrenaline infiltration for hemostasis instead of the tourniquet for carpal tunnel release (Level of Evidence: Therapeutic, IV).24 Tourniquet use for carpal tunnel syndrome is also
decreasing in the United States25,26 and Europe.27,28 The tourniquet is not without risks29; nor is the sedation that is often used to decrease tourniquet discomfort. Sedation-free surgery is inherently safer than surgery with sedation. It has been shown that the tourniquet pain of brief carpal tunnel surgery is twice the pain of the injection of local anesthesia with epinephrine for hemostasis.30 Lido- caine with epinephrine without a tourniquet can therefore decrease patient risk and discomfort. It is particularly helpful in patients who are at high risk with sedation or general anesthesia, and should be offered as an alternative to at least those patients.

A recent study has shown that it takes an average of 26 minutes for maximal vasoconstriction after injection of 1:100,000 epinephrine with lidocaine beneath human arm skin.31 This is why it can be helpful to inject the local anesthetic into the hand before bringing the patient into the operating room.32

Patients will equally prefer whichever anesthesia option they are provided: wide-awake versus sedated.33 However, that same study revealed that sedated patients had much more preoperative testing (e.g., blood work, electrocardiograms, and/or chest radiographs), whereas wide-awake patients spent less time at the hospital. Patients who have been exposed to the wide-awake approach do like it and appreciate the interaction with and education received from the surgeon during the operation.34,35 Minimal pain local anesthesia injection for carpal tunnel release can be reproducibly taught to medical students and residents.36

Local anesthesia that is buffered with bicarbonate37 and that is not refrigerated38 is less painful for carpal tunnel release local anesthesia. Injecting slowly39 and with a smaller gauge needle such as a 27-gauge versus a 25-gauge needle40 also decreases pain.

Endoscopic carpal tunnel release with subcutaneous infiltration of local anesthetic is well tolerated and effective and has lower tourniquet and operating times than intravenous regional anesthesia (Level of Evidence: Therapeutic, II).41 Injection-associated problems such as impaired endoscopic view did not occur in this trial.

EVIDENCE IN OPERATIVE TREATMENT PLAN

Prevention of Infection

A study that examined the rate of surgical-site infections in 3003 patients who underwent carpal tunnel release with and without antibiotics revealed that the routine use of antibiotic prophylaxis is not indicated (Level of Evidence: Therapeutic, III).42 Another smaller study produced the same findings.43

A prospective multicenter study of over 1500 carpal tunnel release procedures revealed that field sterility without preoperative antibiotics yielded a very low superficial infection rate of 0.4 percent, with no deep infections.44 Field sterility means that only a mask and sterile gloves are worn by the surgeon, with no gown. (See Video, Supplemental Digital Content 1, which is an example of epinephrine hemostasis and field sterility and displays a surgeon in a mask and sterile gloves, with no gown. The draping is the equivalent of four towels. The location of surgery is in a clinic minor procedure room environment outside of the main operating room. Most Canadian carpal tunnel procedures are performed this way. This video is available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at http://links.lww.com/PRS/A985.)
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Epineurotomy/Neurolysis versus Simple Decompression

A 1991 study by Mackinnon et al. compared simple decompression of the transverse carpal ligament versus decompression and internal neurolysis of the median nerve. The addition of internal neurolysis did not add significant improvement in the sensory or motor outcome of patients with primary carpal tunnel syndrome.45

In a 2012 trial by Crnković et al., longitudinal epineurotomy conferred no benefit regarding the nerve volume or clinical outcomes over a simple carpal tunnel release (Level of Evidence: Therapeutic, II).46 A 2003 by Borisch and Haussmann study provided similar findings.47

Open versus Mini versus Endoscopic Approach

In 2007, a Cochrane review by Scholten et al.48 determined that no added benefit had been demonstrated by endoscopic over open carpal tunnel release. The authors concluded that the open method should remain the criterion standard because it appeared simpler and less prone to complication. However, they did cite three studies with a total of 294 participants in which endoscopic carpal tunnel release resulted in earlier return to work or activities of daily living than open carpal tunnel release.

A 2004 meta-analysis by Thoma et al.49 reviewed 13 randomized controlled trials. They found that grip and pinch strength in addition to scar tenderness favored endoscopic carpal tunnel release in the first 12 weeks after surgery, but time to return to work was similar. They also found that nerve injuries were higher with endoscopic release, with an odds ratio of 3:1.

Trumble et al. studied open carpal tunnel surgery versus single-port endoscopic release in 192 hands.50 Return to work was shorter with endoscopic release (18 days versus 38 days). Patient satisfaction was better in the first week, and scar sensitivity and pinch and grip recovery were better in the first 3 months with endoscopic surgery.

The improvements in symptoms of carpal tunnel syndrome and hand-related disability 5 years after open and two-portal endoscopic carpal tunnel release were equivalent.51 A recent study comparing open versus endoscopic carpal tunnel release revealed the same findings that many similar studies before it did; endoscopic carpal tunnel release provides a faster recovery for patients undergoing surgery for the first 2 weeks, with faster relief of pain and faster improvement in functional abilities. Paresthesia and numbness subside in an identical manner with the two techniques, and at 1 year postoperatively, both open and endoscopic techniques seem to be equivalent.52

Sutures

Simple interrupted external absorbable sutures showed some benefit to patients in terms of comfort compared with nylon type sutures but otherwise showed no differences.55 Buried absorbable suture is more comfortable to the patient than external sutures for 2 days after surgery.56

EVIDENCE IN POSTOPERATIVE MANAGEMENT

Postoperative Splinting

A bulky dressing replaced with a simple adhesive strip at 2 to 3 days after surgery had the same results regarding wound healing, range of motion, strength, and subjective outcomes as a bulky dressing removed at 2 weeks.57,58 One hundred patients were randomized for having a bulky dressing removed at either 24 hours or 2 weeks postoperatively. The results indicate no difference in outcome between the 2-week and 24-hour groups.59 Another study showed that nonsplinted patients actually fared better in return to activities of daily living, return to work at light and full duty, and recovery of grip and key pinch strength.56 Two other randomized trials have also shown no benefit to postoperative splinting after carpal tunnel release.60,61
Outcomes

A Cochrane review concluded that surgical treatment of carpal tunnel syndrome relieves symptoms significantly better than splinting. In general, outcomes with carpal tunnel release are good, or it would not be the most commonly performed hand surgery operation.

Patients with diabetes have the same beneficial outcome after carpal tunnel release as nondiabetic patients. Only cold intolerance demonstrated a lesser extent of relief for diabetic patients. Release of carpal tunnel in patients on hemodialysis helps alleviation of symptoms caused by median nerve compression and improves the function of hand and quality of life in the majority of patients.

Worker’s compensation patients were slower to return to work or daily activities, whether they were receiving therapy or not. The study by Jugo-vac et al. had similar findings. Macdermid et al. also found a higher rate of dissatisfaction among worker’s compensation patients.

CONCLUSIONS

Carpal tunnel release remains the most commonly performed hand operation. Evidence-based medicine continues to improve our understanding and treatment of this condition. The amount of high-level evidence has recently increased greatly in this condition and helps us to continue improving our practice.

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Volume 133, Number 5 • Carpal Tunnel Surgery


