

Complications of carpal tunnel surgery

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✓ During a 12-year period, the authors treated 25 patients with 26 complications of previous carpal tunnel surgery. Twenty-four of these patients were referred following initial surgery elsewhere. The most frequent complication identified was neuroma of the palmar cutaneous branch of the median nerve in 14 of the cases. Other complications were hypertrophic scars, dysesthesias after multiple procedures to release the carpal tunnel, joint stiffness, failure to relieve symptoms, and neuromas of the dorsal sensory branch of the radial nerve. All of these complications are potentially preventable. With a properly placed incision, exposure carried out under magnification, and surgery under direct vision the majority of these complications may be prevented. It is further noted that the technique of transverse incision at the wrist for release of the carpal tunnel is potentially dangerous and should be abandoned.

KEY WORDS • carpal tunnel syndrome • hand surgery • operative complication • surgical technique • radial nerve

THE carpal tunnel syndrome (CTS) is a clinical problem of frequent occurrence. It was first postulated as a clinical problem by Marie and Foix in 1913.¹¹ They observed the postmortem enlargement of the median nerve proximal to the transverse carpal ligament in a patient who had bilateral thenar atrophy. Learmonth⁸ is credited with the first surgical decompression of the carpal tunnel in 1933. He believed that the increased content of the carpal tunnel caused by proliferative tenosynovitis was responsible for the compression of the median nerve. Now, more than 70 years following the observations of Marie and Foix, and more than 40 years after the first surgical experience of Learmonth with CTS, sufficient experience has accumulated^{1-3,5,6,10,12-16} to consider the results of our surgical endeavors.

Clearly not all individuals who present with CTS require operative surgical management. Rest, splinting, and anti-inflammatory medications are all of value, but to varying degrees. When surgery is indicated for CTS, it is important to remember that significant complications may result if great care is not exercised during the procedure. The symptoms that may ensue following these complications may be more severe and distressing than the patient's original complaint.

Summary of Cases

During the past 12 years we have treated 25 patients with 26 complications resulting from carpal tunnel

surgery. Twenty-four of these patients were referred following initial surgery elsewhere. These complications are grouped in six different categories (Table 1). Only one of these patients had more than one complication, and a total of 26 additional procedures were performed in an effort to correct the complications from the original surgical procedure.

The most frequent complication involved injury to the palmar cutaneous branch of the median nerve. This occurred in 14 instances and in each case it was successfully treated by ligating this branch where it exited from the median nerve in the forearm.

Three patients developed hypertrophic scars as the result of inappropriate incisions. Dysesthesias following multiple carpal tunnel releases plagued three additional

TABLE 1
Summary of complications of carpal tunnel surgery requiring 52 reoperations

Complications	First Reoperation	Subsequent Reoperations
palmar cutaneous neuromas	14	14
hypertrophic scars	3	3
dysesthesias after multiple releases	3	6
stiffness	2	0
failure to relieve symptoms	2	2
radial sensory neuroma	2	1
total operations	26	26

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patients. In two patients the initial procedure involving a transverse incision at the wrist failed to relieve their symptoms. Two other patients developed stiffness of their interphalangeal joints as a result of prolonged immobilization after surgery. One patient developed a neuroma of the superficial branch of the radial nerve due to a radially directed incision that divided a branch of this nerve; this patient also had a neuroma of the palmar cutaneous branch of the median nerve.

A summary of representative cases is given below, with observations relating to the particular problem involved.

Case Reports

Palmar Cutaneous Neuroma Formation

Case 1. This 39-year-old right-handed woman developed numbness and tingling in her right hand. Nerve conduction studies revealed a prolonged distal sensory latency and delayed conduction across the carpal tunnel segment. Night splints and anti-inflammatory medication failed to relieve her symptoms. Surgery to decompress the carpal tunnel was performed in October, 1972, with an incision that followed the thenar crease. During the 3rd week of the postoperative period, she developed tenderness that was localized to a very discrete point along her incision (Fig. 1 *left*). Percussion over this area caused symptoms that were described as "like electricity." The symptoms failed to respond to expectant management and the wound was subsequently reexplored, revealing a neuroma of the palmar cutaneous branch of the median nerve. This branch was ligated at its point of exit from the median nerve in the distal forearm. The patient subsequently had relief of all of her symptoms but the inevitable numbness developed in the overlying thenar muscle mass, the area of sensory innervation of this nerve.

Comment. The course of the palmar cutaneous branch of the median nerve is shown in Fig. 1 *right*. As pointed out by Taleisnik¹⁵ and by Carroll and Green,¹ the nerve is in particular jeopardy during carpal tunnel surgery. The nerve may arborize as demonstrated by Taleisnik so that branches cross the interthenar crease. The use of magnification is a valuable aid in avoiding these branches and thus preventing injury and neuroma formation. When the nerve is approached by means of a transverse incision at the wrist, this branch may likewise be cut. There are many other possible complications from the use of the transverse incision, such as failure to divide the transverse carpal ligament, division of the motor branch of the median nerve, and division of the superficial palmar arch. Using this incision renders the procedure not only blind but potentially injurious to the patient, and we strongly believe that it should be abandoned. When a neuroma has developed in the palmar cutaneous branch of the median nerve, we have found that ligating the branch underneath the cover of the flexor digitorum superficialis of the long finger, where it arises from the

median nerve, eliminates the symptoms. The small area of numbness that results at the base of the thenar muscles has not been a significant clinical problem in our experience.

Hypertrophic Scar Formation

Case 2. This 42-year-old woman underwent carpal tunnel release by means of an incision that crossed the wrist perpendicular to the flexion creases. Her preoperative symptoms abated but as healing progressed she developed an annoying and unsightly hypertrophic scar at the proximal end of the incision. A Z-plasty was performed that relieved the tension upon this band by converting it to a transverse scar.

Comment. The preferred incision for the release of the carpal tunnel does not need to cross the wrist flexion creases (Fig. 2 *left*). The confluence of the transverse carpal ligament and the antebrachial fascia may be divided proximal to the skin incision by using retractors to elevate the skin and by dividing the ligament and fascia under direct vision. When it is necessary to cross the wrist flexion creases, as in releasing Guyon's canal or when performing a tenosynovectomy, it is best to



FIG. 1. *Left:* Case 1. The interthenar portion of this incision is appropriate. The area where it is marked is just distal to the wrist flexion creases. This is the point at which the palmar cutaneous branch of the median nerve was divided across the interthenar area. This was successfully treated by ligating this branch where it exited from the median nerve proper in the distal forearm. *Right:* The palmar cutaneous branch of the median nerve is marked in this specimen with black marker as it is seen to exit from the radial side of the median nerve proper approximately 4 inches proximal to the wrist flexion creases. In this instance, it arborized between the thenar muscle masses and certainly would be prone to injury at this level. This illustrates the need for magnification and great care to protect these branches during the course of carpal tunnel surgery.

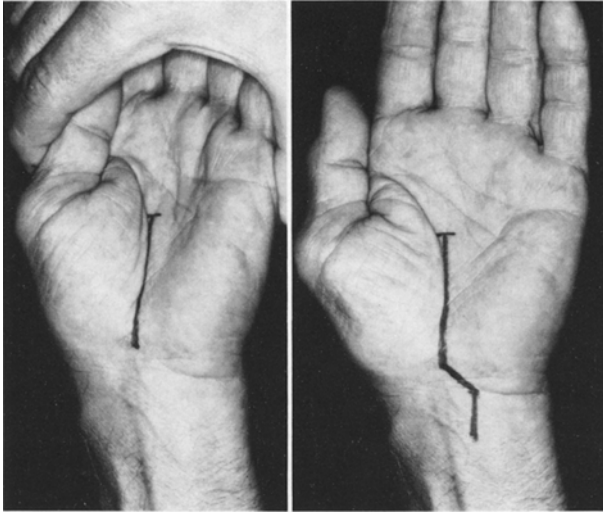


FIG. 2. *Left:* In most circumstances release of the carpal tunnel can be done satisfactorily with the incision depicted here. The confluence of the transverse carpal ligament and antebrachial fascia can be seen under direct vision by appropriate retraction of the proximal edge of the skin, thus avoiding crossing the wrist flexion creases. *Right:* When it is necessary to cross the wrist flexion creases, it is best done in the fashion shown, with the incision crossing the wrist flexion creases at approximately 45°. This avoids tension on the incision line and hypertrophic scar formation. In addition, it deviates away from the palmar cutaneous branch of the median nerve. The palmar sensory branch of the ulnar nerve may be visualized with this incision, and should be looked for.

cross the wrist flexion creases obliquely and toward the ulnar (Fig. 2 *right*). The incision may then be directed as proximally as one elects without harm.

Dysesthesias After Multiple Releases

Case 3. This 54-year-old right-handed grocery store cashier developed symptoms of median nerve compression at the wrist, which was confirmed by nerve conduction studies. She underwent release of her carpal tunnel by an interthenar incision which did not cross the wrist flexion creases. During the early postoperative period her preoperative symptoms of numbness, tingling, and nocturnal awakening disappeared. Approximately 8 weeks after surgery her symptoms gradually reappeared. Because of the persistence of her symptoms, her surgeon reoperated on her hand 6 months after the initial procedure. At the second operation an internal neurolysis was performed. The surgeon noted in the operative report that no unusual compression was seen, nor was a definite cause for her recurrent symptoms found. Following the second procedure the patient developed dysesthesias in the median nerve distribution of her right hand. The index and long finger tips were hypersensitive to touch and the palmar incision was exquisitely sensitive.

At this point she consulted us because of her severe

symptomatology. Upon examination the findings were as reported above. Nerve conduction studies revealed delayed conduction across the carpal tunnel segment. In addition, there was prolonged distal latency of the median sensory components. After a period of conservative management, reexploration was deemed advisable. The patient was warned that she might not achieve any improvement, but her distress was so great that she elected to accept the operative risk.

At the time of her third operation the median nerve was found to be displaced volarly and encased in scar between the remnants of the transverse carpal ligament. With the help of the operating microscope a neurolysis of the individual fascicles was carried out. The nerve was relocated to a more dorsal position and the subcutaneous tissue and skin were closed in layers. Despite early postoperative relief following this procedure she subsequently returned to a dysesthetic state, although her palmar incision sensitivity was considerably diminished. Five years after her last procedure, she is unemployed and has great difficulty in using her hand for any activity.

Comment. In 1972, Langlosh and Linscheid⁵ reported their extensive experience at the Mayo Clinic with "Recurrent and unrelieved carpal-tunnel syndrome." In 20 of 33 patients whom they reexplored, the transverse carpal ligament was incompletely sectioned at the initial surgery. Following reexploration, 75% of their patients were considered normal or improved. Three of the patients in our series had three carpal tunnel releases on their symptomatic hand. They all remain symptomatic with dysesthesias in the median nerve distribution. This complication is clearly preventable and further points out the need for careful and thorough exploration at the time of any carpal tunnel release procedure.

Joint Stiffness

Case 4. This 52-year-old female nurse underwent release of her carpal tunnel by means of the standard interthenar incision. During her postoperative course, she was immobilized for 1 month with a bulky hand dressing and a plaster-of-paris splint which restricted wrist mobility. Her first postoperative examination was scheduled for 1 month following the procedure. She denied having been given any instructions regarding mobility of her fingers, and she failed to initiate digital flexion and extension prior to that visit.

At the time of the first dressing change there was marked swelling of the digits with limited mobility of both proximal and distal interphalangeal joints. An intensive course of physical therapy was instituted which included the use of dynamic splinting to overcome the flexion contracture. At the conclusion of this treatment the patient's preoperative symptoms had been relieved, but she was left with a permanent contracture of her proximal interphalangeal joints that averaged a 25° loss of extension.

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Failure to Relieve Symptoms

Two patients were seen who had a failure to relieve their symptoms due to an inadequate initial surgical procedure.

Case 5. This 54-year-old engineer developed symptoms consistent with CTS. The symptoms were particularly apparent at night and while driving his car to and from work. A carpal tunnel release was performed by one of us (D.S.L.). The patient's symptoms did not subside. Reexploration was performed 3 months after the initial procedure. The striking finding at the second procedure was a persistent band of fascia proximal to the proximal palmar skin incision that made a definite indentation upon the nerve just at the juncture of the transverse carpal ligament with the antebrachial fascia. After release of this band the patient's symptoms were completely relieved.

Case 6. The second patient had an inadequate release due to the use of a transverse incision at the wrist where a pair of scissors was passed blindly from a proximal to distal direction in an effort to divide the ligament. Upon reexploration, there was scarring in the subcutaneous tissue and palmar fascia but the transverse carpal ligament was intact. Release of the ligament resulted in complete relief of symptoms.

Radial Sensory Neuroma

Case 7. One patient developed a neuroma of the dorsal sensory branch of the radial nerve as well as a neuroma of the palmar cutaneous branch when the incision utilized was extended proximally and radially (Fig. 3 *left*). The branch of the nerve that was involved with the neuroma was dissected proximally, leaving the neuroma intact. It was then buried deep to the flexor carpi radialis muscle belly. Following this procedure, the symptoms from the superficially located neuroma subsided. A small area of anesthesia at the base of the thumb persisted but was not unduly annoying.

Comment. The volar branching of the dorsal sensory branch of the radial nerve may leave it vulnerable to injury with a radially directed incision (Fig. 3 *right*).

Discussion

As experience accumulates, it is apparent from recent reports^{1-3,5,6,10,12} that complications following carpal tunnel surgery are unfortunately quite common. It is also obvious that with care all of these complications are preventable. Based upon our experience and that of others, certain points are clear and deserve emphasis.

It must be stressed that there is no anatomical justification for the transverse incision to release the carpal tunnel.^{1,2} The palmar cutaneous branch of the median nerve is prone to injury by this ill-advised incision. The anatomical variations of the motor branch of the median nerve⁷ make it susceptible to injury with this blind approach. The superficial palmar arch is also in peril when it is not directly visualized during carpal tunnel

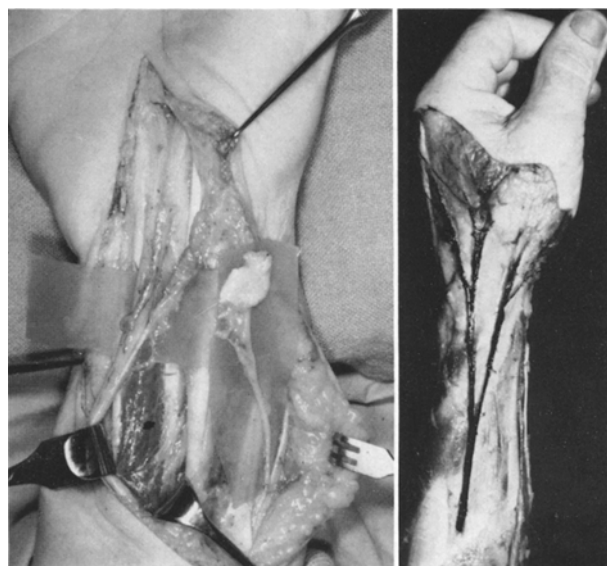


Fig. 3. *Left:* Case 7. Neuromas of the dorsal sensory branch of the radial nerve and of the palmar cutaneous branch of the median nerve are visualized in this clinical surgical photograph. The neuroma of the dorsal sensory branch of the radial nerve was left intact and translocated deep to the muscle belly of the flexor carpi radialis, thus eliminating the symptoms. The neuroma of the palmar cutaneous branch of the median nerve was ligated at its exit from the median nerve and the nerve was relocated deep to the superficialis muscle belly of the long finger. The anticipated areas of numbness resulted; however, the painful symptoms that were due to the neuromas were eliminated, much to the patient's satisfaction. *Right:* The dorsal sensory branch of the radial nerve in this specimen has been marked with an opaque ink, illustrating that the branches of its volar division may proceed in a path that will leave them vulnerable to a radially directed incision at the wrist.

release. There is no doubt that unless the transverse carpal ligament is seen throughout its course, the completeness of its division will remain a matter of hope, faith, and speculation.

The appropriate incision for the individual carpal tunnel problem under consideration will depend upon the etiology of the particular case. In certain situations, the release of the carpal tunnel will require a more extended incision than in the usual case of the idiopathic CTS. For example, when the CTS is concomitant with rheumatoid arthritis, a volar tenosynovectomy may be necessary as part of the decompression procedure. In such a situation, a proximal extension of the usual interthenar incision may be necessary. When it is necessary to extend the incision proximal to the wrist flexion creases, these creases should be crossed obliquely ulnarward in order to avoid the palmar cutaneous branch and also to prevent the formation of a hypertrophic scar.

In most cases, the diagnosis of the CTS can be made on clinical grounds largely based upon the patient's history of numbness and tingling in the median nerve

distribution with nocturnal exacerbation and awakening. As one gains experience, it becomes evident that electromyography and nerve conduction studies do not usually assist in the decision to proceed with surgical release. If the studies are abnormal they re-enforce the decision to operate. If they are normal in the presence of a classical symptom complex, then surgery should be carried out anyway.⁴ Most of the time, therefore, it is not cost-effective to carry out these studies on a routine basis. When a release of the carpal tunnel has failed to relieve the patient's symptoms, a careful re-evaluation of the patient is mandatory. If preoperative electromyography and nerve conduction studies were not performed initially, they should be performed following a failed carpal tunnel release. Such studies may then reveal the presence of an unsuspected problem, such as involvement at the cervical spine level, with posterior myotome involvement, or they may reveal the presence of an unsuspected generalized peripheral neuropathy. Such studies might also reveal entrapment at a more proximal level such as that seen in the pronator teres syndrome.

Other complications of surgery upon the carpal tunnel that have been reported include hematoma formation,¹⁰ volar displacement of the nerve so that it has become entrapped between the healing edges of the transverse carpal ligament,⁵ and bowstringing of the flexor tendons¹⁰ when an extended proximal excision was not accompanied by adequate postoperative immobilization. Reflex sympathetic dystrophy, nerve injury,^{2,3,9,12} and flexor tendon adherence have also been reported. We have not seen any of these complications in our own series of approximately 300 patients.

Based upon our experience we believe that there is a preferred incision for the release of the carpal tunnel (Fig. 2 right). The confluence of the transverse carpal ligament with the antebrachial fascia can be released under direct vision by the appropriate use of retractors proximally, thus eliminating the necessity to cross the wrist flexion creases with a proximal extension of the skin incision. When a more extensive proximal incision is needed, as when dealing with an anomalous superficialis or palmaris muscle or when performing an extensive volar tenosynovectomy, then the wrist flexion creases should be crossed obliquely in an ulnar direction. It is also important to remember that not all of the pain that is present in a patient with CTS is necessarily due to the syndrome. We agree with Lichtman, *et al.*,⁹ that, with proper patient selection, carpal tunnel

release may be done satisfactorily under tourniquet control with local anesthesia as an outpatient procedure.

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