

Comparison of Carpal Tunnel Release Methods and Complications

Loretta Coady-Fariborzian, MD; and Amy McGreane, DNP, ARNP-BC

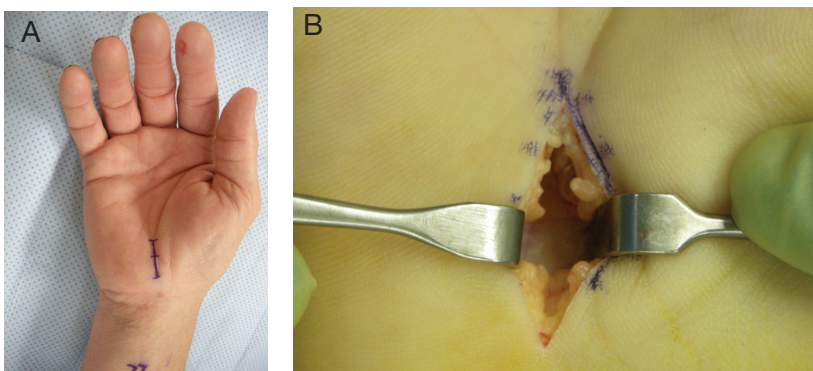
A comparison of endoscopic and open methods of carpal tunnel release finds no difference in postoperative complications but a statistically significant increase in wound dehiscence for the open method.

Carpal tunnel release is one of the most common hand surgeries performed at the North Florida/South Georgia Veterans Health System (NFSGVHS). Depending on surgeon experience and comfort level, surgeries are performed through either the traditional open method or the endoscopic method, single or double port (Figures 1 and 2). The advantage of the endoscopic method is faster recovery and return to work; however, the endoscopic method requires more expensive equipment and a steeper learning curve for surgeons. Complications are uncommon but can create unsatisfactory patient experiences because of costly lost workdays and long travel distances to the medical facility.

The purpose of this study was to compare the endoscopic method with the open carpal tunnel release method to determine whether there was an increased complication risk. Researchers anticipated that this information would help surgeons better inform patients of operative risks

Dr. Coady-Fariborzian is the section chief of plastic surgery at the Malcom Randall VAMC and a clinical assistant professor at the University of Florida, both in Gainesville. **Dr. McGreane** is a doctor of nursing practice at the North Florida/South Georgia Veterans Health System in Jacksonville.

Figure 1. Open Release Method for Carpal Tunnel



A, Preoperative markings. B, Intraoperative view.

and prompt changes in NFSGVHS treatment plans to improve the quality of veteran care.

METHODS

An Institutional Review Board-approved (#647-2011) retrospective review was done of patients who had carpal tunnel surgery performed by the NFSGVHS plastic surgery service from January 1, 2005, to December 31, 2010. Surgeries included in the review took place at the Malcom Randall VAMC in Gainesville and at the Lake City VAMC, both in Florida. Most of the surgeries included in the study were performed by a resident or fellow under the supervision of an attending physician. Eight different

attending surgeons staffed the operations. Seven were board-certified or board-eligible plastic surgeons, 2 had advanced hand fellowship training, and 1 was a general surgeon with hand fellowship training. All hand fellowship-trained surgeons were in their first year of practice at the time of the study.

Only primary carpal tunnel releases were included in the study. Exclusion criteria included patients who were operated on by a service section other than the plastic surgery service (orthopedics or neurosurgery) and hands on which other procedures were performed during the same operation. Charts were reviewed for up to 1 year post

surgery. Complications that required intervention were recorded. Researchers did not include pillar tenderness or an increase in occupational therapy visits as complications, due to the wide variety of patient tolerance to postoperative pain and varying motivation to return to work and daily routine.

Methods of release were endoscopic, open, or endoscopic converted to open. All but 6 of the completed endoscopic surgeries were performed using the double port Chow technique. The other 6 endoscopic surgeries were performed using the single port Agee technique at the distal wrist crease. There were 3 endoscopic converted to open cases that were performed using a single port, proximally-based technique in the midpalm. This method was abandoned after 3 unsuccessful endoscopic attempts, 1 resulting in digital nerve injury despite interactive cadaver labs prior to operative experience.

Endoscopic surgeries converted to open were recorded as open surgeries, because the patients had the full invasive experience. Researchers used the chi-square test and P value $< .05$ to compare the different methods of carpal tunnel release with identified complications.

RESULTS AND COMPLICATIONS

A total of 584 hands belonging to 452 patients were included in the study. Patients included 395 men and 57 women aged from 33 to 91 years. There were 271 endoscopic releases, 228 open releases, and 85 endoscopic converted to open releases. The NFSGVHS conversion rate was 23.7%. Complications in the converted cases ($n = 4$) were in-

cluded in the open release results.

There were 40 complications in 38 hands. The overall complication rate was 6.5%. Complications noted were tendonitis presenting as De Quervain disease or trigger finger (9 endoscopic surgeries; 6 open surgeries), infection (2 endoscopic surgeries; 6 open surgeries), wound dehiscence (5 open surgeries), nerve injury (1 open surgery), respiratory distress (1 endoscopic), complex regional pain syndrome (1 open surgery), and scheduled returns to the operating room (OR) for recurrent, ongoing, or worsening symptoms (5 endoscopic surgeries; 5 open surgeries). Complications with an $n > 1$ were evaluated for statistical significance with P value $< .05$ (Table 1).

The NFSGVHS study had 10 patients return to the OR for open exploration (Table 2). Nine of these patients went back to the OR based on symptoms consistent with nerve conduction studies that had deteriorated compared with their preoperative studies. One endoscopic case was brought back to the OR for a suspected nerve injury without nerve conduction studies. Findings during reoperation included scar adhesions, incomplete release of ligaments, digital nerve injury, and negative explorations.

Figure 2. Endoscopic Release Method for Carpal Tunnel



A, Preoperative markings. B, Intraoperative view.

Two hypothenar fat transfers were performed to prevent scar adhesions in cases that had originally been open releases.¹ Two of the open cases were endoscopic converted to open cases. One went back to the OR with a suspected nerve injury. Dense adhesions and an injured common digital nerve were identified and repaired. The second converted case that went back to the OR had a suspected, but unconfirmed, nerve injury to the motor branch. The diagnosis and treatment were delayed for more than a year due to the patient having other pressing medical and family concerns. An exploration found significant scar adhesions, and an opponensplasty was performed.

One patient had respiratory insufficiency secondary to chemical pneumonitis. The patient was sedated during an endoscopic carpal tunnel release, aspirated, and kept intubated in the intensive care unit until the morning after surgery.

An early complex regional pain syndrome diagnosis was made in a patient with underlying neuropathy and a preoperative “profound” median neuropathies diagnosis at the wrist with underlying peripheral neuropathy found on nerve conduction studies. The patient experienced an unusual amount of postoperative pain and edema after an

Table 1. Endoscopic vs Open Surgery Complications

Complication	Endoscopic (n = 271)	Open (n = 313)	P Value
Tendonitis	9	6	.28
Infection	2	5	.34
Dehiscence	0	5	.04
Return to operating room	5	5	.82
Hands with complications	18	20	.90

uncomplicated open carpal tunnel release. This was treated with rapid intervention using anti-inflammatories and hand therapy. The patient also started a regimen of skin care, edema management, neuroeducation, and contrast baths. Symptoms responded within a week.

There were 12 wound complications: 10 in open and 2 in endoscopic surgeries. Total wound complications were equally split between patients with and without diabetes. Infection and dehiscence were noted. Sutures were removed an average of 9.6 days after surgery in the patients whose wounds broke down. A statistically significant relationship was found only between the open method of release and wound dehiscence ($P < .05$).

There was no statistically significant difference in the overall complication rate in the NFSGVHS population when comparing endoscopic with open carpal tunnel release or when comparing the risk of postoperative tendonitis, wound infection, or return to the OR.

DISCUSSION

Carpal tunnel syndrome was documented by James Paget in mid-19th century in reference to a distal radius fracture.² It is the most common peripheral nerve compression, with an incidence ranging from 1 to 3 cases per 1,000 subjects per year

and a prevalence of 50 cases per 1,000 subjects per year.³ In an active-duty U.S. military population, the incidence of carpal tunnel syndrome is 3.98 per 1,000 person years.⁴

The endoscopic method of release was first introduced in 1989 by Okutsu and colleagues.⁵ About 500,000 carpal tunnel releases are now performed in the U.S. every year, with 50,000 performed endoscopically.³ There were 185 carpal tunnel releases (56 endoscopic and 129 open) performed at the NFSGVHS in 2012.⁶ The minimally invasive procedure was designed to preserve the overlying skin and fascia, promoting an earlier return to work and daily activities. This is particularly relevant for manual workers who desire rapid return of grip strength. Multiple published reports have found more rapid recovery based on a reduction in scar tenderness, increase in grip strength, or return to work.⁷⁻¹³ Patients seem to have equivalent results over the long term, ranging from 3 months to 1 year.^{7,8,13-15} Return to work was not evaluated in this study, because many patients were either retired or not working steadily.

The endoscopic method was criticized after its introduction due to its potential increase in major structural injury to the median nerve, ulnar nerve, palmar arch, ulnar artery, or flexor tendons.¹⁶

A meta-analysis found improved outcomes but a statistically significant higher complication rate in endoscopic, compared with open release (2.2% in endoscopic vs 1.2% in open).¹⁶ Referral patterns have found iatrogenic nerve injury in patients referred by surgeons without formal hand fellowship training.¹⁷ There is a wide variety of background training for surgeons who may offer carpal tunnel release, including plastic surgery, orthopedics, general surgery, and neurosurgery.

Major structural injuries were reported by hand surgeons using both open and endoscopic methods in a questionnaire sent to members of the American Society for Surgery of the Hand, indicating that either approach demands respect.¹⁸ A large review of the literature from 1966 to 2001 by Benson and colleagues found that the endoscopic approach was not more likely to produce injury to tendons, arteries, or nerves compared with the open approach and actually had a lower rate of structural damage (0.49% vs 0.19%).¹⁹ Researchers who conducted this study confirmed one common digital nerve injury in an endoscopic converted to open technique, using a distally-based port with the blade not being deployed via the endoscopic method. The endoscopic method has been found to have a higher rate of reversible nerve injury (neuropraxia) compared with the open technique.^{7,10,19}

The NFSGVHS results found a higher rate of wound dehiscence. More frequent wound site complications, particularly infection, hypertrophic scar, and scar tenderness have been noted using the open method.^{3,8,20} This is probably due to the deeper and slightly larger incision used for the open method compared with the smaller and shallower incisions used for the endoscopic release.

Table 2. Reoperative Carpal Tunnel Release

Patient	Surgery Type	Preoperative Symptom(s)	Postoperative NCV/EMG	Findings	Treatment
1	Endoscopic	Persistent	Worse	Negative	Open exploration 19 months later
2	Endoscopic	Persistent	Not done	Incomplete release	Open exploration and release of TCL 2 weeks later
3	Endoscopic	Recurrence	Worse	Proximal fascia band	Open exploration and release of antebrachial fascia 13 months later
4	Endoscopic converted to open	Persistent	Worse	CDN injury, dense adhesions	Open exploration and repair of CDN and hypothenar fat transfer 3.5 months later
5	Open	Persistent	Worse	Scar adhesions	Open exploration and hypothenar fat transfer 9 months later
6	Endoscopic	Persistent	Worse	Distal TCL intact	Open exploration and release of TCL 7 months later
7	Endoscopic converted to open	Recurrence	Worse	Scar adhesions	Open exploration and opponensplasty 15 months later
8	Open	Persistent	Worse	Negative	Open exploration and hypothenar fat transfer 5.5 months later
9	Open	Persistent	Worse	Dense adhesions	Release of scar adhesions (previous postoperative infection) 3 months later
10	Endoscopic	Persistent	Worse	Incomplete release	Open exploration and release of TCL 20 months later

Abbreviations: CDN, common digital nerve; EMG, electromyography; NCV, nerve conduction velocity; TCL, transverse carpal ligament.

There is the inevitable learning curve for the endoscopic release due to the more complicated nature of the procedure. The NFSGVHS conversion rate was 23.7% over the 5-year period from 2005 to 2010. All 3 fellowship-trained hand surgeons were in their first year of practice at the time of the study, so the authors anticipate a lower conversion rate in forthcoming studies. The NFSGVHS researchers did not consider converting to an open technique to be a complication and believe it is appropriate to teach plastic surgery residents and fellows to have a low threshold to convert when visualization is not optimal and the potential for significant injury exists. The learning curve and a higher conversion rate have been acknowledged by Beck and colleagues with no increase in morbidity.²¹

The authors anticipated finding an increased rate of tendonitis in

the endoscopic method, as found by Goshtasby and colleagues, where trigger finger was found more frequently in the endoscopic patients.²² The NFSGVHS study found that the number of patients presenting for steroid injections to treat postoperative tendonitis in the hand and wrist was not statistically significant when comparing the 2 surgical methods of release (3.3% in endoscopic vs 1.9% in open; $P = .28$).

The NFSGVHS rate of return to the OR within a year of surgery was 1.7%. The researchers from NFSGVHS anticipated a higher rate of return to the OR for ongoing symptoms secondary to incomplete release of the transverse carpal ligament. Published studies have found an intact retinaculum to be a cause of persistent symptoms when smaller incisions are used.^{23,24} Five endoscopic cases and 5 open cases eventually returned to the OR

for carpal tunnel exploration. Two of the patients were classified as recurrent, because they had improvement of symptoms initially but presented > 6 months later with new symptoms. Eight of the patients were classified as persistent, because they did not have an extended period of relief of preoperative symptoms (Table 2).²⁵ There was no statistically significant difference in return to the OR in the 2 study groups. The NFSGVHS researchers did note a trend in more incomplete nerve releases in the endoscopic group and more scar adhesions as the etiology of symptoms in the open group who went back to surgery.

Published studies have found no difference in overall complication rates when comparing the open with the endoscopic method of release, which is consistent with NFSGVHS data.^{8,11,12,26}

A limitation of the current retrospective study is the large number of providers who both operated on the patients and documented their postoperative findings. The strength of the study is that VA patients tend to stay within the VISN for their health care so postoperative problems will be identified and routed to the plastic surgery service for evaluation and treatment.

Clinical implications for the NFSGVHS practice are that surgeons can confidently offer both the open and endoscopic surgeries without an overall risk of increased complications to patients. Patients who are identified as higher risk for wound dehiscence, such as those who place an unusual amount of pressure on their palms due to assisted walking devices or are at a higher risk of falling onto the surgical site, will be steered toward an endoscopic surgery. The NFSGVHS began a splinting protocol in the early postoperative period that was not previously used on those select patients who have open carpal tunnel releases.

CONCLUSION

Wound dehiscence was the only statistically significant complication found in the NFSGVHS veteran population when comparing open with endoscopic carpal tunnel release. This can potentially be prevented in future patients by delaying the removal of sutures and prolonging the use of a protective dressing in patients who undergo open release. There was not a statistically significant increase in overall complications when using the minimally invasive

method of release, which is consistent with existing literature. ●

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