Long-term outcomes following single-portal endoscopic carpal tunnel release

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Abstract

Background There is limited published information about long-term outcomes and recurrence rates following single-portal endoscopic carpal tunnel release.

Methods We reviewed symptom and function outcomes from a prospectively collected database of patients who underwent single-portal endoscopic carpal tunnel release at a minimum of 8 years follow-up. Out of 207 patients in the original database, we were able to confirm correct current contact information for 106 patients. Of these, 91 patients with 115 single-portal endoscopic carpal tunnel releases agreed to participate. All of these patients were eligible for this long-term follow-up study based on documented preoperative and 6-month postoperative Levine-Katz questionnaire scores. Patients then completed a current update of the Levine-Katz questionnaires to assess function and symptom outcomes at latest follow-up.

Results The average 6-month postoperative scores were significantly lower compared with the average preoperative scores and were maintained at long-term follow-up. There were no significant differences in average change in scores at long-term follow-up compared to 6-months postoperative.

Conclusions Single-portal endoscopic carpal tunnel release is an effective surgical treatment for carpal tunnel syndrome. Low recurrence rates and maintenance of low symptom and function scores can be expected at 8 to 10 years following this technique.

Keywords Carpal tunnel recurrence rates · Endoscopic carpal tunnel release · Outcome

Introduction

Authors and surgeons disagree about the long-term outcomes and recurrence rates for endoscopic carpal tunnel release (ECTR). This may be one of the reasons that many surgeons choose to not perform ECTR [17]. At a minimum, all surgeons seek to release the transverse carpal ligament (TCL) when performing carpal tunnel release. Surgical options are traditional open release and smaller incision techniques such as endoscopic or limited open release. Some authors have reported faster recovery and less scar tenderness with these minimally invasive techniques [18, 20, 22]. However, some have also reported concerns with these techniques including possible longer operating room times [6], increased chances of incomplete release, possible higher early recurrence rates [4, 15, 25], and more severe complications [5, 7, 19, 21]. In the hand surgery community, we do not have a large amount of evidence on long-term outcomes and recurrence rates for all of these techniques, including single-portal endoscopic release.

Investigators have used various methods to objectively assess short and long-term outcomes following carpal tunnel surgery, including assessment of strength [2], 2-point discrimination, [6, 26], and/or nerve conduction testing [2, 9]. Patient-rated outcome measures have also been used to evaluate the results of carpal tunnel surgery [11, 14, 20]. In addition, comparative studies have allowed surgeons to evaluate relative outcomes for open, endoscopic, and other minimally invasive techniques [6, 15, 20, 22]. Although authors have described earlier postoperative recovery for endoscopic methods compared to traditional open procedures, there is no universal agreement that this benefit exists. Multiple authors have cited variable results and nearly all suggest there are no long-term benefits to minimally invasive techniques when compared to the benefits obtained from open carpal tunnel release [15, 16, 23]. It is important for surgeons to identify long-term carpal tunnel release (CTR) symptom and functional outcomes and

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recurrence rate to help decide what may be the best technique for patients. Our primary goal for this study is to determine if improvements in the carpal tunnel symptom and function scores following single-portal endoscopic carpal tunnel release are maintained at long-term follow-up. We also wanted to determine the recurrence rate following single-portal endoscopic carpal tunnel release for patients in our database.

Materials and Methods

We have maintained a carpal tunnel database at our institution for patients enrolled between April 2001 and March 2003. We originally designed the database as a tool to collect prospective data on 2 years of consecutive patients who were scheduled for carpal tunnel surgery. We have used this database to report various outcomes relating to carpal tunnel syndrome and surgery. All patients scheduled for any form of carpal tunnel release in a hand surgery practice composed of ten surgeons with Certificate of Added Qualifications in Surgery of the Hand were eligible and were asked to participate. Willing participants were enrolled into the database before surgery. Of those patients who went on to have surgery, a total of 384 hands were followed to completion of the database, 311 of which had single-portal endoscopic release and 73 of which had open release. To be included in the final surgical database, all patients had to have documented preoperative and 6-month postoperative Levine-Katz (L-K) Symptom (L-KS) and Function (L-KF) Questionnaire scores (also known as the Boston Carpal Tunnel Questionnaire).

For this study, after obtaining Institutional Review Board approval, we searched the database to identify all patients who had their surgery at least 8 years ago. We then excluded patients who had insufficient pre- or postoperative documentation, had prior carpal tunnel surgery, had a history of significant trauma about the carpal tunnel, had renal disease requiring hemodialysis, or had other neurologic confounding issues such as peripheral neuropathy or cervical radiculopathy. We identified 338 hands in 261 patients who met these criteria. Of this total cohort, 269 hands in 207 patients had undergone single-portal ECTR. For primary carpal tunnel surgery, some surgeons in our group routinely perform endoscopic release whereas some routinely perform open release. The choice of procedure was left up to the surgeon-patient decision-making process and was not influenced by patient age, sex, or weight. If patients were converted from an endoscopic to an open procedure for technical reasons, the change was documented and these patients were switched to the open group. We were able to confirm a correct current mailing address and/or phone number for 106 out of the 207 patients who had undergone ECTR (51 %). Of these patients, 91 (86 %) with 115 surgeries agreed to participate. These patients completed repeat L-K questionnaires to assess long-term function and symptom

outcomes and returned the questionnaires via mail. Patients were also asked if they had developed any of a list of confounding variables or had sought treatments or modified work or recreational activities because of carpal tunnel symptoms since their 6-month postoperative follow-up. To limit potential interviewer influence, we did not have any patient complete the questionnaires over the phone.

Statement of Informed Consent

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from all patients for being included in the study.

We used analysis of variance to compare L-KS or L-KF scores between presurgery, 6 months after surgery, and at long-term follow-up. As a working definition, we considered a difference of 0.5 points in L-K scores for both symptom and function as a clinical change. We defined recurrence as an initial clinical decrease at 6 months after surgery followed by a clinical increase in long-term score. We considered the number of hands each patient had surgery on as the unit of analysis rather than using the number of patients. By doing this, we ensured that patients who had open surgery on one hand and endoscopic surgery on the other hand or had recurrence in one hand but not the other would not be excluded.

Results

The mean long-term follow-up was 8.9 years (range 8–10.7 years). The initial patient demographic data and comorbidities are listed in Table 1. Table 2 lists the results for L-K

Table 1 Patient demographic data and comorbidities

<i>n</i> (patients)	91
Age (years)	54.1±0.9 ^a
Years from surgery	8.9±0.1 ^a
Female (%)	77.4
Bilateral surgery (%)	58.2
Dominant hand (%)	53.9
Any comorbidity (%)	55.7
Diabetes (%)	9.0
Thyroid (%)	22.5
Gout (%)	3.6
Trauma of the wrist (%)	0.9
Trauma of the hand (%)	3.6
Arthritis of the wrist (%)	17.1
Arthritis of the hand (%)	7.2
Other (%)	23.4

Error term is standard error of the mean

^a Standard error of the means

Table 2 Mean and standard error of the means for initial, 6-month postoperative, and minimum 8-year long-term postoperative Levine-Katz Symptom and Function scores for single-portal endoscopic carpal tunnel release

	ECTR					
	<i>n</i>	Initial	SE	6 months	SE	Long term
L-KS	115	2.87	0.08	1.34	0.05	1.27
L-KF	115	2.38	0.08	1.37	0.06	1.25

symptom and function scores preoperatively, 6 months postsurgery, and at latest follow-up of at least 8 years. Both L-KS and L-KF mean scores improved (i.e., decreased) for all patients significantly by 6 months and were maintained at long-term follow-up without any significant worsening (Figs. 1 and 2).

Based on individual L-K scores, 12 ECTR patients (15 of 115 hands, 13 %) had initial improvement of at least 0.5 points at 6 months postsurgery and then had a worsening of more than 0.5 points at long-term follow-up, thus meeting our definition of recurrence. Newly diagnosed confounding variables since the initial 6-month postoperative score included thyroid disease (4), diabetes (2), rheumatoid arthritis (1), gout (1), peripheral neuropathy (1), trigger finger (1), anxiety/depression (1), wrist/hand arthritis (5), cervical spine arthritis (2), and an incomplete spinal cord injury at C3/C4 (1). When controlling for these new confounding variables that can negatively affect L-K scores independent of carpal tunnel syndrome, there were three ECTR patients (three hands) with recurrence (3 % recurrence rate). Of these three patients, two had not sought any further treatments for carpal tunnel syndrome and one patient had made alterations to activities and hobbies because of carpal tunnel syndrome and had physical therapy. One other patient reported splint use for carpal tunnel symptoms at long-term follow-up. We did not define

Fig. 1 Changes in L-KS scores following surgery. There was a significant decrease (improvement) in average L-KS score at 6 months postoperative compared to initial preoperative. There was no significant difference in the average L-KS score at 6 months postoperatively compared to final long-term follow-up. Analysis has been adjusted for age

Figure 2 Changes in L-KF scores following surgery. There was a significant decrease (improvement) in average L-KF score at 6 months postoperative compared to initial preoperative. There was no significant difference in average L-KF score at 6 months postoperative compared to final long-term follow-up. Analysis has been adjusted for age

this patient as having recurrence because the patient did not have initial clinically significant improvement in L-K score followed by clinically significant worsening in L-K score. The patient may have had persistent carpal tunnel syndrome after the first surgery, may have been incorrectly diagnosed as having carpal tunnel syndrome, or the L-K tool may have not been sensitive enough to detect improvement after the initial surgery. This patient may have had another undiagnosed reason for using the splint but thought they were using it for carpal tunnel syndrome. This patient also developed diabetes as a confounder after the 6-month postoperative follow-up. No other patients in the entire 91-patient cohort reported using any treatments for carpal tunnel symptoms at final follow-up.

Discussion

Our study has a follow-up period for patients treated with single-portal ECTR of at least 8 years. Patients had significantly improved average symptom severity and functional scores at long-term intervals compared with their baseline preoperative scores. Our results highlight the potentially low incidence of carpal tunnel syndrome recurrence in the long-term follow-up period for this surgical technique.

Previous investigators have examined several differences between endoscopic and open techniques (see Table 3 for a summary of these papers) [1, 3, 4, 8, 10–13, 24]. In Table 3, for each study, we used the authors' definition of recurrence when available or, when the L-K questionnaire was used, as close as possible to the same definition as we used in our study. Although Atroshi et al. assessed the two-portal technique and did not specifically define recurrence, their results highlight similar outcomes at an intermediate follow-up period, similar to our findings at longer-term follow-up [1]. Keiner et al. reported no

Table 3 Summary of carpal tunnel release studies

Study	Design/LOE	Number of hands	Minimum length of f/u (years)	Recurrence rate (%)	Evaluation tool for recurrence	Repeat surgery rate (%)
Atroshi et al. [1]	PRCT/1	63 DP-ECTR 63 OCTR	5	~10 ~6	L-K	~2 ~3
Weber et al. [24]	Case series/4	29 LOCTR	5	n/a	MHQ	~3
Keiner et al. [10]	Case series/4	94 DP-ECTR	5	0	Telephone satisfaction scale	0
Hankins et al. [8]	Case series/4	2,163 DP-ECTR	10	n/a	Symptoms	~3
Chow/Hantes [4]	Case series/4	2,402 DP-ECTR	4	<1	Symptoms/exam	<1
Concannon et al. 3	Case/control/3	88 DP-ECTR 103 OCTR	n/a	7 0	Chart review/repeat surgery rate	7 0
Kulick et al. [12]	Case series/4	130 OCTR	2	~5	Return of paresthesias	0
Langlois/Linscheid [13]	Case series/4	2,053 OCTR	n/a	~2	Repeat surgery	~2

LOE level of evidence, f/u follow-up, n/a not available or not applicable, PRCT prospective randomized controlled trial, DP-ECTR double-portal endoscopic carpal tunnel release, SP-ECTR single-portal endoscopic carpal tunnel release, OCTR open carpal tunnel release, LOCTR limited-open carpal tunnel release, L-K Levine-Katz Carpal Tunnel Questionnaire also known as the Boston Carpal Tunnel Questionnaire, MHQ Michigan Hand Questionnaire.

long-term recurrences after dual-portal endoscopic release but three patients underwent early revision open release at 3- to 6-months postoperatively due to persistent symptoms [10]. In one of these, they found an incomplete release of the TCL and after open release the patient's symptoms improved. In the other two patients, they found that the TCL had been completely released by the initial procedure and open release did not significantly improve the patients' symptoms. Concannon et al. noted that 6 out of 88 patients had recurrence following dual-portal ECTR and underwent revision OCTR at a median of 8.5 months [4]. Five of those six patients had symptom relief. The authors did not mention whether they found evidence of incomplete TCL release in this group who had relatively early return of symptoms. They noted that all but one of the ligaments had healed completely; the patient with the ligament that had not healed was the only one to not have symptom resolution after revision open release.

Although we enrolled our patients prospectively when collecting the original database, this is a retrospective review of that database. We may also be limited by biases related to patient and surgeon preference about the choice of procedure as well as surgeon experience. All of the surgeons who participated in this database held the Certificate of Added Qualification in Surgery of the Hand. However, we did not have data on how many carpal tunnel release procedures each surgeon had performed before starting the database. We also lost approximately 50 % of our patients at long-term follow-up but were satisfied that over 85 % of those not lost to follow-up agreed to participate. At such a long period of follow-up, especially for a procedure that typically requires a relatively short length of follow-up, our loss of approximately 50 % of

patients at long term is not surprising. As with most studies that depend on follow-up participation by patients, there is a risk that those patients who agree to participate constitute a different population than those who do not or those who are lost to follow-up, thus possibly biasing the data. Despite this limitation, our study represents, to the best of our knowledge, the largest group of long-term follow-up on patients undergoing single-portal endoscopic carpal tunnel release reported in the literature to date. Although we used an accepted patient-based outcomes tool, we did not have patients return for objective examination or formal neurodiagnostic studies. Although we used hands as the unit of analysis, there is always the potential problem of patients with bilateral surgery who tend to have more similar L-K scores than hands from different patients. There were many more patients available for this review who had single-portal endoscopic release because of most of our surgeons' preference for this technique for most primary carpal tunnel surgeries. We were therefore limited in our ability to compare open and endoscopic techniques directly at the long-term follow-up.

The strengths of our study include long-term follow-up of at least 8 years performed by multiple surgeons at a single institution, use of a validated patient-rated carpal tunnel syndrome measurement tool which was a written assessment without interviewer assistance, and a relatively high participation percentage in those patients not lost to long-term follow-up. This information is lacking in current literature and is cited as a reason for some surgeons to recommend against endoscopic release. Our results also differ from some prior reports with regard to potential early and late recurrence rates for endoscopic release and support the idea that low long-term recurrence rates can be achieved with single-portal endoscopic release.

Conflict of Interest Kenneth R. Means Jr. declares that he has no conflicts of interest.

Norman H. Dublin declares that he has no conflicts of interest.

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All authors have (1) reviewed the final version of the manuscript; (2) believe it represents valid work; (3) approve it for publication; (4) certify that none of the material in the manuscript has been previously published, is included in another manuscript, or is currently under consideration for publication elsewhere; (5) certify that this article has not been accepted for publication elsewhere, nor have any rights or interests in the manuscript been assigned to any third party; and (6) the data upon which the manuscript is based and will be produced if the editor of *Hand* requests it.

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Statement of Informed Consent Informed consent was obtained from all patients for being included in the study.

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