Endoscopic Carpal Tunnel Release

Brian D. Adams, MD

Abstract

On the basis of clinical outcome measures, endoscopic carpal tunnel release is an effective operation for treating idiopathic carpal tunnel syndrome. Patients who have undergone bilateral carpal tunnel operations have routinely preferred endoscopic release over the open release. An endoscopic release allows many patients to return to work sooner. However , the benefits of more rapid functional recovery and return to work are tempered by the increased cost and higher complication rate of the procedure. Endoscopic carpal tunnel release is a technically demanding procedure with low tolerances for error. Despite its widespread use, its role is not yet clearly defined.

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Endoscopic carpal tunnel release (ECTR) has generated a diversity of responses since its introduction in 1989 by Okutsu et al.[1] Proponents of the procedure claim that postoperative morbidity is less, leading to more rapid recovery of hand function. Opponents cite a higher incidence of operative complications and increased cost. In this article, scientific publications and presentations will be reviewed so that the merits and drawbacks of the procedure can be assessed by the reader. However, this topic is dynamic and controversial. Thus, diligent review of forthcoming information will be required to stay current with the clinical and economic implications of this procedure.

Technique

Although it is not the intent of this article to present a detailed description of ECTR techniques, a review of the essential operative steps may help those unfamiliar with ECTR to better appreciate the potential benefits and complications. Two approaches have been developed, the single- portal method and the two-portal method.

The single-portal method uses one incision placed in the wrist-flexion crease between the flexor carpi ulnaris and the flexor carpi radialis tendons. A distally based rectangular flap in the antebrachial fascia is raised to gain entrance to the carpal tunnel. After the synovial tissue has been cleared from the undersurface of the transverse carpal ligament, dilators are inserted, followed by the ECTR device (Fig. 1). Once the distal edge of the ligament has been visually defined with the endoscope and the aim of the device has been confirmed, the release is performed from distal to proximal under direct vision. A blade is elevated at the tip of the device by a trigger mechanism in the case of the Agee technique.

The two-portal technique uses a second incision in the palm to expose the superficial palmar arch, the common digital branches of the median nerve, and the distal edge of the transverse carpal ligament. With the wrist in extension, a trocar-and-cannula assembly is passed from the proximal incision through the carpal tunnel to exit from the distal incision superficial to the neurovascular structures. An endoscope is inserted through the proximal portal of the cannula to visualize the undersurface of the ligament. A series of special knives are inserted from the distal portal to divide the distal half of the ligament under direct vision. The endoscope and knives are then inserted from the opposite directions to divide the proximal half of the ligament.

Chow originally described a transbursal approach in which the cannula was placed within the synovial cavity of the carpal tunnel. However, the technique has since been modified to use the extrabursal approach developed by Agee for the single-portal technique because of its better visualization and safety.

Although these are the basic steps of the procedures, the actual surgical protocols are much more detailed.

Dr. Adams is Associate Professor, Department of Orthopaedic Surgery, University of Iowa, Iowa City.

Reprint requests: Dr. Adams, University of Iowa, Department of Orthopaedic Surgery, Iowa City, IA 52242.

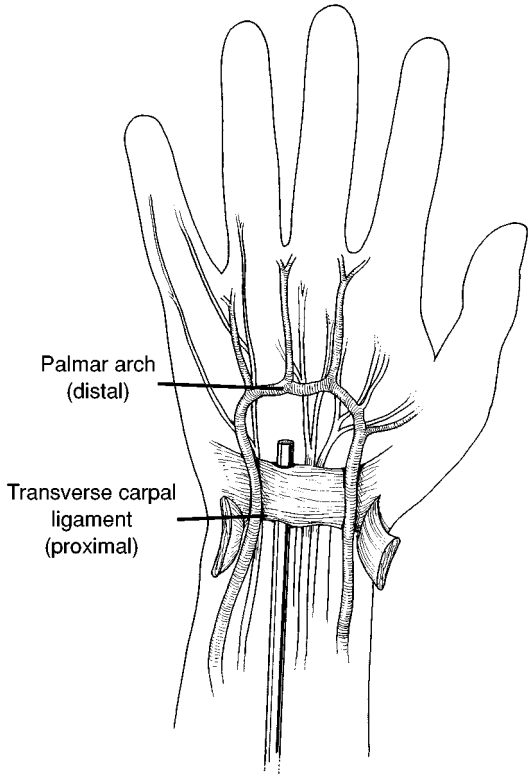

Fig. 1 The small safe area that must be identified for both the single- and two-portal ECTR techniques is bounded proximally by the distal edge of the transverse carpal ligament and distally by the palmar neurovascular structures.

Formal hands-on training in a cadaveric laboratory session is essential before performing the technique clinically.

Efficacy

The physiologic efficacy of ECTR has been established by several clinical studies using multiple outcome measures. Carpal tunnel pressures decrease and electrophysiologic nerve responses improve equally with ECTR and open release.[2,3] Relief of pain and paresthesias and recovery of two-point discrimination are consistently achieved with ECTR.[2,4] With the use of magnetic resonance imaging, Peimer et al[5] found that increases in canal volume are equivalent with ECTR and open release. Carpal-arch widening occurs, but to a slightly lesser degree than with open release.[6] This finding may be beneficial, since arch widening has been associated with pillar pain (i.e., prolonged postoperative pain at the bases of the thenar and hypothenar eminences). Thus, decompression of the median nerve is effectively achieved with ECTR in patients with idiopathic carpal tunnel syndrome (CTS).

The lack of an opportunity to perform a simultaneous flexor tenosynovectomy and/or neurolysis is a cause of concern for surgeons who believe that these procedures are important adjuncts to carpal tunnel release. However, neurolysis has been shown not to be advantageous in the initial surgical treatment of idiopathic CTS.[7] In addition, tenosynovectomy is best reserved for patients with inflammatory conditions; according to most surgical protocols, ECTR is not indicated for these patients.

Other outcome measures have demonstrated greater variability in clinical studies. These measures are in large part responsible for both the alleged advantages and the controversies surrounding ECTR. Nevertheless, with the exception of return-to-work status, the benefits of ECTR are limited primarily to the early postoperative period, with differences in outcome measures becoming less distinct after the third through sixth postoperative weeks.[2,4,8] Thus, a major premise for advocating endoscopic release is to return patients more rapidly to work.

In two multicenter prospective studies comparing ECTR with open release, patients returned to work significantly sooner (range, 14 to 29 days) after ECTR.[2,4] The study by Agee et al[4] demonstrated a much greater difference in the non–worker's compensation (NWC) group than in the worker's compensation (WC) group (7 versus 29 days). In a single-center prospective study, Palmer et al[8] also demonstrated a shorter return-to-work interval for endoscopically treated patients. For the NWC patients, the off-work period averaged 27 days with an open release, 20 days with the Chow method, and 11 days with the Agee method. Although NWC patients fared better, significant differences were also found for the WC patients between ECTR and open release. In the WC group, time off work averaged 56 days with an open release, 35 days with the Chow method, and 29 days with the Agee method.

Despite the measurement of multiple clinical variables in these studies, the factors responsible for the

more rapid return to work after ECTR remain unclear. Decreased scar tenderness and quicker return of grip strength are thought to play a significant role. Agee et al[4] found improved key-pinch and grip strength and decreased scar tenderness during the first 3 postoperative weeks. Similar findings were reported by Palmer et al[8]; however, the differences in outcome measures persisted for longer intervals in their patients. Brown et al[2] reported improved key-pinch and less late scar tenderness; however, grip strengths were equivalent in the ECTR and open-release groups, although the ECTR patients returned to work more rapidly (14 days).

Several factors may be responsible for the variations in these outcome measures among reports, including the use of different endoscopic devices and different study designs. Chow[9] reported that 29% of patients returned to normal activities and work within 1 week, 59% within 2 weeks, 75% within 3 weeks, and 86% within 4 weeks. Twenty percent of his cases involved WC patients. Other authors have used a similar reporting method.[10-12] The studies by Agee et al[4] and Palmer et al[8] are the only published series that distinctly separated WC patients from NWC patients. In addition, the percentage of patients with manual labor occupations will clearly influence the return-to-work statistics in a clinical series. Thus, comparisons among studies are difficult when different groupings of patients are used in the analysis.

The difficulties raised by variations in patient populations and reporting methods are further compounded by the lack of a control group in most studies. Only three reported series[2,4,8] have included a cohort group of patients who underwent an open release.

Economic Factors

Since ECTR has been closely tied to medical-economic issues from the outset, the procedure has been subjected to cost-effectiveness analyses much earlier and more critically than most procedures have. In fact, few orthopaedic operations have received similar cost scrutiny. Although cost is a central issue in today's health care delivery, most studies on operative procedures are not designed to accurately address cost. Thus, whether one is for or against ECTR, care should be exercised when interpreting cost data. Despite these reservations, a discussion of cost issues is integral to the topic of ECTR.

Disability costs are generally two thirds of the total cost of a hand problem. Therefore, the saving to employers and insurance carriers from an earlier return to work has been cited as a significant advantage of ECTR. Palmer et al[8] calculated that the state of Minnesota could save $4.9 million a year by returning CTS patients to work 27 days earlier using ECTR. This figure is based on an estimated weekly saving of $443 per person in compensation benefits. Brown et al[2] estimated a similar weekly cost saving based on lost-wages compensation alone without including other entitlements. In addition, decreased company productivity due to the employee's absence often causes an additional financial loss of similar magnitude.

These potential cost savings are tempered by the increased cost incurred with the endoscopic technique, including the initial equipment purchase and the per-case cost of disposable blades. The cost of a device can range from $5,000 to $6,000, and individual blades are approximately $150.

Differences in operating time and anesthetic methods also impact total cost, but are more difficult to assess since there are variations in preferences and techniques among surgeons. Brown et al[2] reported a slightly longer operating time for ECTR, but their data were collected during the earlier experiences of several investigators in the study. Others claim the operating times are equivalent. Expense related to the anesthetic method is probably the most significant factor that varies, whether the procedure is performed endoscopically or openly. The minimal recommendation is that all endoscopic procedures be performed with anesthesia personnel available to administer intravenous sedation. In many cases, regional blocks are preferred by surgeons. Since many surgeons perform open releases with local anesthetic alone, a separate anesthesia charge is avoided, thus making the cost differential significant.

In addition, formal instruction at a cadaver workshop is highly recommended and often required for hospital privileges to perform this procedure. For this training, surgeons incur the cost of tuition and travel expenses.

Complications

Although the economic issues surrounding ECTR are timely and important, the risks of the procedure are the cause for the greatest concern to physicians and patients. The procedure is technically oriented and requires special training. However, this is true of many new surgical procedures and does not necessarily imply undue risk. It is the low tolerances for error caused by the close proximity of important palmar structures that make ECTR potentially more prone to intraoperative complications than other endoscopic or arthroscopic techniques.[13-15]

In a cadaver study, Rotman and Manske[13] demonstrated the ana-

tomic relationships of the Agee device to surrounding structures (Fig. 2). When positioned correctly for carpal tunnel release, the blade elevates an average of 3.1 mm from the median nerve. The available distance for blade elevation between the distal edge of the transverse carpal ligament and the superficial palmar arch averages 4.8 mm. Their study clearly demonstrates that failure to position the device precisely can cause serious injury to nerves and vessels.

Although some claim that the two-portal method is safer, several cadaver studies have demonstrated that the technical and anatomic considerations demand similar precision and that the procedure is equally challenging. In addition, Rotman[16] demonstrated in a laboratory study that the cannula of the two-portal system may inadvertently pierce the substance of the transverse carpal ligament (Fig. 3), resulting in an unrecognized incomplete release.

Thus far, a distinct overall advantage for either the single- or the two-portal approach has not been established. Most serious neurovascular injuries with any ECTR technique seem to occur when the device is malpositioned or, more important, when visualization is not ideal.

Neurovascular injury rates from large multicenter surveys are listed in Table 1. These statistics entail the inherent reporting errors associated with surveys, but have the advantage of relating the experiences of a large number of surgeons. In contrast, the results reported from single institutions have shown considerable variation, ranging from no injuries to serious complications, including nerve lacerations. Thus, injury rates are not well established for ECTR. Currently available information should probably be used only as a general guideline. However, the general consensus among surgeons is that nerve injuries occur with greater frequency with an endoscopic method than with open release.

Determining the relative increased risk with ECTR is difficult since the nerve injury rate for an open release is not well defined. On the basis of a literature review, North has reported that a reasonable estimate of the nerve injury rate for open release is 0.16% (data presented at the Instructional Skills Course on ECTR, 47th Annual Meeting of the American Society for Surgery of the Hand, Phoenix, November 11-14, 1992). He concluded that the injury rate with ECTR was 1.5 to 2.5 times greater than that with an open release.

Because operative complications are most often related to the low tolerances for error, many surgeons, both proponents and critics of ECTR, have stated that a steep learning curve exists. In the July 1992 issue of *The American Academy of Orthopaedic Surgeons Bulletin* (p. 12), Chow describes ECTR as a technically demanding surgical procedure that requires the surgeon to have highly trained motor skills. He reports that most of the complications in a current multicenter study appear to have occurred within the first 20 cases. In contrast, Feinstein[17] reported that his first complication with ECTR occurred during the 59th case and concluded that experience with the procedure does not decrease the risk of a serious complication. A familiarity with other endoscopic techniques or arthroscopy is probably beneficial. However, ECTR does not offer improved visualization for carpal tunnel release as arthroscopy does for many joint procedures. Thus, ECTR lacks the ease of use and many of the operative benefits of other fiberoptic procedures.

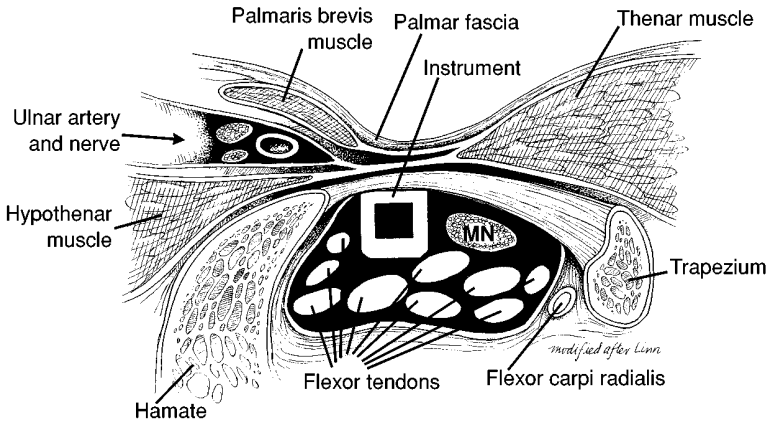

Fig. 2 Transverse section depicting position of Agee endoscopic blade assembly relative to carpal tunnel structures. MN = median nerve.

Current Viewpoints

Despite concerns and controversies, there is widespread and growing use of ECTR by a variety of surgeons with different backgrounds and patient populations. It is difficult to ascertain the most important factor driving this popularity; however, patient satisfaction is likely to be substantially influencing surgeon preferences. On the basis of a survey of hand surgeons, Schenk reported

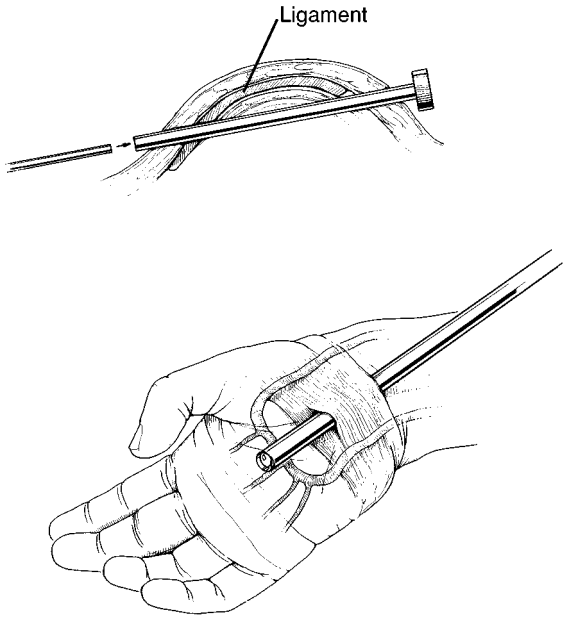

Fig. 3 With the two-portal system, inadvertent penetration of the cannula through the substance of the transverse carpal ligament proximal to its distal margin results in incomplete carpal tunnel release.

that patients "greatly favored" the endoscopic technique (data presented at the 22nd Annual Meeting of the American Association for Hand Surgery, Washington, DC, September 17-19, 1992).

Most reports have focused very little on patient preference. Although it is a subjective measure, a comparison of different procedures in patients with bilateral disease can potentially provide a high degree of objectivity to this variable. Feinstein[17] found that 9 of 11 patients preferred endoscopic release over open release. Since current outcome studies are increasing their focus on patient satisfaction in assessing the effectiveness of a medical intervention, this outcome measure deserves greater emphasis.

Perhaps the greatest contribution thus far from the introduction of ECTR has been the tremendous increase in the breadth and depth of interest in CTS that it has helped to generate. Surgeons are reassessing their conventional approach to carpal tunnel release with greater emphasis on postoperative morbidity. Smaller incisions and new surgical approaches using two incisions or special retractors are becoming common practice. These modifications will likely improve the surgical care of patients with CTS.

Equally important, information on ECTR has helped physicians to better recognize the impact that CTS has on society. Series with large numbers of patients undergoing ECTR have been reported by single institutions and in multicenter studies. It is estimated that well over 200,000 carpal tunnel releases are performed each year in the United States. Undoubtedly, ECTR is a potentially lucrative market for surgical supply companies. Many devices are currently being marketed. In my opinion, the newer devices do not offer any significant advantages over the earlier ones introduced by Agee and Chow. However, clinical trials that would allow objective cpmparison of the older and newer devices have yet to be published in peer-reviewed journals.

Clearly, CTS is not only a medical issue, and the method of surgical treatment is only one factor in the care of this pervasive problem. Although the medical-economic issues related to the surgical treatment of CTS are the most evident, the benefits of physician involvement in ergonomic issues, including prevention through work modification, are gaining increased awareness.

On the basis of available information and personal experience, I believe that ECTR offers potential benefits when used for specific indications related to a patient's rehabilitative needs. Surgeons considering the use of ECTR should be aware that

Table 1
Multicenter Surveys of Nerve Injury Rates With Three ECTR Devices

Survey	No. of Patients	Device	Nerve Injury Rate, %
Agee*	2,447	Agee (original)	0.39
Chow*	2,887	Chow	0.39
Agee†	685	Agee (revised)	0.15
Schenk*	6,833	Agee (original)	0.3
		Chow	0.8

*Data presented at the Instructional Skills Course on Endoscopic Carpal Tunnel Release, 47th Annual Meeting of the American Society for Surgery of the Hand, Phoenix, November 11–14, 1992.
†Data from the "Agee Carpal Tunnel Release System Surgeon Acceptance Evaluation" (performed February–September 1992), 3M Health Care, St. Paul.

several reports have cautioned against widespread routine application to all patients requiring surgical treatment until the safety of the procedure is improved. However, to condemn ECTR at this point, as some surgeons advocate, may well hinder the development of more reliable and effective techniques to treat CTS.

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