Early major complications of endoscopic carpal tunnel release: A review of 1200 cases

Raymond W Tse MD, Lawrence N Hurst MD FRCSC FACS, Tawfeik A Al-Yafi MD FRCSC

RW Tse, LN Hurst, TA Al-Yafi. Early major complications of endoscopic carpal tunnel release: A review of 1200 cases. Can J Plast Surg 2003;11(3):131-134.

Although the early benefits of endoscopic carpal tunnel release have been demonstrated, there is great controversy regarding the risks and safety of the technique. The present study reports early major complications in a series of 1278 consecutive cases performed by a single surgeon over a seven-year period. All procedures were performed under local anaesthesia on an outpatient basis using the Agee single portal technique. Mean follow-up was three months.

No vascular, tendon or permanent nerve injuries were documented. Recurrent or persistent symptoms occurred in 7% of patients for which 20 of 89 underwent subsequent open carpal tunnel release. No nerve injuries were found on re-exploration. Other complications were consistent with previously reported incidences.

This is the largest reported case series by a single surgeon and represents an accumulation of surgical experience at the upper end of the learning curve. Endoscopic carpal tunnel release is a safe procedure in this experienced single surgeon series.

Key Words: *Carpal tunnel syndrome; Complications; Endoscopy*

Complications majeures précoces de la libération endoscopique du nerf médian au niveau du canal carpien

Bien que les bénéfices précoces de la libération endoscopique du nerf médian au niveau du canal carpien soient démontrés, il existe une grande controverse au sujet des risques et de l'innocuité de la technique. La présente étude fait état de complications majeures précoces dans une série de 1 278 cas consécutifs opérés par un seul chirurgien en l'espace de sept ans. Toutes les interventions ont été exécutées sous anesthésie locale en clinique externe au moyen de la technique portale unique d'Agee. Le suivi moyen était de trois mois.

Aucune lésion vasculaire, tendineuse ou nerveuse permanente n'a été documentée. Des symptômes récurrents ou persistants se sont manifestés chez 7 % des patients, et 20 de ces 89 patients ont subi une libération ouverte du nerf médian au niveau du canal carpien. Aucune lésion nerveuse n'a été découverte au moment de la deuxième exploration. D'autres complications étaient compatibles avec des incidences déclarées auparavant.

C'est la plus grande série de cas à être déclarée par un seul chirurgien, et elle représente une accumulation d'expérience clinique dans le haut de la courbe d'apprentissage. La libération endoscopique du nerf médian au niveau du canal carpien est une intervention sûre dans le cadre de cette série effectuée par un seul chirurgien expérimenté.

Open release of the transverse carpal ligament has been the surgical standard of care for median nerve decompression in carpal tunnel syndrome. With the advent of endoscopic surgical techniques and the significant morbidity of a large palmar incision associated with open carpal tunnel release (OCTR) techniques, endoscopic carpal tunnel release (ECTR) was introduced with the theoretical advantage of being much less invasive. By using a small incision and releasing only the transverse carpal ligament, median nerve decompression could be achieved without the morbidity of a large palmar skin incision and subcutaneous tissue dissection, thereby minimizing postoperative pain and allowing a faster return of strength and functional abilities. Although endoscopic techniques of carpal tunnel release were introduced over a decade ago, their roles have yet to be clearly defined.

Relative to OCTR for median nerve decompression, ECTR has significant advantages. Prospective controlled trials have found equivalent postoperative patient satisfaction and pain relief for 85% to 97% of patients with either ECTR or OCTR (1-3). However, when scar tenderness ratings in controlled studies are compared, ECTR has been associated with significantly better ratings during the first nine to 24 weeks after the operation (2-5). Furthermore, objective grip strength testing has found ECTR to be associated with a significantly greater return of strength during the initial two to 12 weeks after operation relative to OCTR (3-7).

In addition to the subjective and objective clinical advantages, ECTR has been associated with earlier return of functional abilities and performance of useful work. Although several studies have found no difference between techniques with respect to average time for return to work (1,8,9), others have reported a significantly shorter recovery time with ECTR. In randomized prospective trials, the average time to return to work was 14 days with ECTR relative to 28 to 39 with OCTR (2,6). The trend becomes clear and consistent when patients in the nonworkers' compensation subgroup are isolated. Patients who were not on workers' compensation who were treated with ECTR returned to work after an average of 11 to 23 days, whereas those treated with OCTR returned to work after an average of 27 to 46 days (4,5,8). No significant difference was demonstrated in the workers' compensation group. The clinical and functional advantages of ECTR are thus well delineated and consistently reproduced, especially in the population who are not on workers' compensation.

Division of Plastic Surgery, Department of Surgery, University of Western Ontario, London, Ontario
Correspondence: Dr LN Hurst, Division of Plastic and Reconstructive Surgery, University of Western Ontario, London Health Sciences Centre, University Campus, 339 Windermere Road, London, Ontario N6A 5A5. Telephone 519-663-2921, fax 519-663-2907

TABLE 1
Patients with persistent or recurrent symptoms of carpal tunnel syndrome – alternative diagnoses, reasons for and outcomes of conservative management, and operative findings at open carpal tunnel release

Alternate diagnosis – 9 wrists (10%)	Persistent or recurrent symptoms – 90 wrists Conservative management – 57 wrists (63%)	Open carpal tunnel release – 24 wrists (27%)
4 Fibromyalgia	17 Normal nerve conduction study following ECTR	6 Incomplete release
2 Recurrence with pregnancy	19 Significantly improved nerve conduction study following ECTR	9 Scar tissue
1 Dupuytren's pretendinous band	7 Refused OCTR	5 Inflammation
1 Ganglion in carpal tunnel on MRI	8 Symptoms improved after four to six months	2 No obvious pathology
1 Suspected secondary gain	2 Age/medical condition precluding further surgery	0 Nerve injury
	4 Lost to further follow-up	

ECTR Endoscopic carpal tunnel release; MRI Magnetic resonance imaging; OCTR Open carpal tunnel release;

Whereas the short term outcomes of carpal tunnel release have been well studied, little has been reported on long term results. Haupt et al (10) found 'improvement' in 86% of cases at a median follow-up of 5.5 years with OCTR, while Nancollas et al (11) reported 'good or excellent' outcomes in 87% of patients at an average of 5.5 years following OCTR. Erhard et al (12) reported on long term outcomes of ECTR at a mean follow-up of 4.5 years, with a success rate of 72% of patients being symptom-free and 94% of patients being functionally normal. Although further investigation is required in this area, long term results of ECTR appear to be similar to OCTR.

Although short term advantages and acceptable long term outcomes have been demonstrated for ECTR, great controversy continues to revolve around the safety of the technique. These concerns stem from early reports of major complications during the introduction and spread of ECTR methods. The purpose of the present study was to examine the safety of the single portal endoscopic carpal tunnel release technique with respect to major early postoperative complications.

METHODS

A retrospective chart review was conducted of all cases of ECTR performed by the senior author over a seven-year period from January 1993 to December 2000.

Patient evaluation was based on history, physical findings and electrophysiological studies. All patients had either clinical evidence of carpal tunnel syndrome or positive nerve conduction studies for median nerve entrapment across the carpal tunnel. Contraindications to ECTR included previous carpal tunnel release, rheumatoid arthritis, inflammatory conditions, amyloidosis, prior wrist fracture or trauma and previous significant procedures in the area of the wrist.

Surgery was performed on an outpatient basis under tourniquet control, with 0.5% plain Bupivicaine (Abbot Laboratories, St-Laurent, Quebec) to produce a regional block for anaesthesia. Tourniquet time was three to 17 min with a mean of 7 min. Carpal tunnel release was carried out using the 3M Agee endoscopic device (3M Company, USA) in all cases. A 1 cm transverse skin incision was placed along the proximal wrist crease between the palmaris longus and flexor carpi ulnaris tendons. A blunt dissector was then passed deep to the fascia to create a potential space. After landmarking the distal edge of the transverse carpal ligament, it was divided under direct visualization upon withdrawal of the endoscopic device. Complete transection of the ligament was ensured and a second pass was employed as necessary. Patients were managed postoperatively with instructions for daily range of motion exercises and a soft dressing that was removed after 48 h.

RESULTS

A total of 1278 ECTR procedures on 958 patients were performed during the study period. Forty-two wrists in 27 patients were excluded. Of these, 37 wrists in 22 patients were lost to follow-up and five wrists in five patients underwent conversion to open release. Reasons for converting to an open procedure included thick synovium (three wrists), a tight tunnel (one wrist), and a synovial cyst discovered within the tunnel (one wrist). The patient age range was 17 to 97 years with a mean age of 52 years. Thirty-five per cent of the patients were male. Sixteen per cent of cases were Workers' Compensation Board related. The duration of symptoms before surgery ranged from three weeks to 30 years. Eighty-four per cent of the patients were Phalen's sign positive and 79% of the patients were Tinel's sign positive. Nerve conduction studies were positive in 94% of patients while 3% of the patients had normal studies. The remaining 3% did not have electrophysiological studies. The right wrist was operated on in 56% of cases and the left was operated on in 44% of cases. Fifty per cent of procedures were on a single wrist, while 24% were on bilateral wrists at the same surgery and 26% were on bilateral wrists at separate surgeries. Mean follow-up time was three months (range from 10 days to four years). Both the surgeon and an independent hand therapist evaluated patients for nerve and tendon function.

On review of patient charts there were no vascular injuries, tendon injuries or nerve injuries. Ninety wrists (7.3%) had either persistent or recurrent symptoms. Of these, 10% were given an alternate diagnosis, 63% were managed conservatively, and 27% underwent subsequent OCTR (Table 1). Of those patients who underwent open exploration, none were found to have any nerve injury. Incomplete release of the transverse carpal ligament and dense scar tissue were the most common operative findings (Table 1). None were found to have any nerve injury on open exploration following ECTR. Other complications are noted in Table 2.

DISCUSSION

Concern regarding the safety of ECTR accompanied the growth and spread of ECTR. Along with the early clinical experience came numerous reports of major complications including median (13-16), ulnar (17) and digital nerve (18) transections; superficial palmar arch injuries (2,3,19); and flexor tendon laceration (19). In spite of the concerning nature of

TABLE 2
Minor complications of endoscopic carpal tunnel release

Complication	Wrists (n)	Incidence (%)
Minor bleed/hematoma	1	0.1
Infection – managed as outpatient	15	1.2
Infection – requiring admission	1	0.1
Pillar pain	354	28.6
Hypertrophic scar	16	1.3
Tender scar	62	5.0
Reflex sympathetic dystrophy	11	0.9

these reports, such complications were reported soon after the introduction of ECTR and represented the early, and oftentimes preliminary, experience with this technique. Opponents of ECTR often cite early cadaveric studies (20-22) that reported high incidences of major complications; however, these studies utilized wrists that had undergone ECTR by inexperienced surgeons who were first learning the technique. Therefore, results of these studies represent surgical experience at the bottom end of the well-recognized learning curve in performing ECTR. Conversely, the results of the case series reported here represent seven years of surgical experience.

ECTR was performed on 1273 wrists of which 1241 were available for follow-up. There were no major complications involving vascular, tendon or nerve injuries based upon perioperative and postoperative evaluation. Furthermore, of those patients requiring revision with OCTR, none were found to have nerve injuries on re-exploration. On reviewing the literature, this study was found to report the largest case series by a single surgeon. As such, it reflects an accumulation of surgical experience with ECTR and represents skill on the upper portion of the learning curve. Thus, in the hands of a surgeon with both adequate experience and sufficient practice volume, ECTR can be employed as a safe technique in the surgical management of carpal tunnel syndrome. The senior author notes several technical pearls in Table 3.

Although OCTR is still regarded as the standard of surgical care for carpal tunnel syndrome, the technique has also been associated with major nerve, tendon and vascular complications (23,24). Palmer and Toivonen (25) recently reported a survey sent to members of the American Society for Surgery of the Hand comparing major complications of ECTR and OCTR. A large number of major nerve, vascular and tendon injuries was associated with both techniques; however, because this was a voluntary survey with no report on the actual number of procedures performed, the true incidence of complications could not be inferred. Another study aimed at comparing major complications of OCTR and ECTR was reported by Boeckstyns and Sørensen (26). Although a meta-analysis could not be performed, reports according to study type were tabulated following a Medline search. A total of 54 publications, reporting on 9516 endoscopic and 1203 open releases, was analyzed. When all 'controlled' studies (randomized prospective, nonrandomized prospective, and retrospective) were tabulated, the rates of major complications did not significantly differ. On review of the literature, ECTR has never been demonstrated to be associated with a significantly greater incidence of major complications relative to OCTR.

CONCLUSIONS

Several conclusions can be drawn from review of the literature and the results of this study. First, surgical release of the carpal tunnel for decompression of the median nerve is associated with rare, but potentially devastating, nerve, tendon and vascular complications. Greater incidences of such complications have not been shown in the literature with ECTR relative to OCTR. Thus, the suggestion that ECTR places patients at greater risk of major complications has not been validated. Furthermore, the majority of reported ECTR complications occurred at the introduction of the technique, representing experience at the low end of the learning curve. In this series of 1241 cases of ECTR, there were no major nerve, tendon or vascular injuries. For this single experienced surgeon at the upper portion of the learning curve, ECTR is a safe procedure. Finally, in spite of the demonstrated subjective and functional advantages of ECTR, the technique should not be used with all patients, and ECTR should only be performed after careful preoperative selection.

ACKNOWLEDGEMENTS: The authors thank Cathy Marsh and the LHSC University Campus Medical Records Department for their assistance in this study. The authors have not and will not receive any royalties from the manufacture, distribution, sale or clinical use of the 3M Agee Endoscopic Carpal Tunnel Release system.

TABLE 3
Technical pearls for single portal endoscopic carpal tunnel release

1. The palmar cutaneous branch of the median nerve is avoided by ensuring the initial incision is always ulnar to the palmaris longus tendon.
2. The antebrachial fascia should be incised gently to avoid breaching the subfascial bursa. Note that the antebrachial fascia can appear to have two layers.
3. The synovial dissector should be kept in a plane volar to the bursa as a film of synovium will otherwise conceal the underside of the flexor retinaculum to obstruct clear visualization.
4. By inserting the endoscope up against the retinaculum, the synovium can be kept clear of the surgical view.
5. The ridges of the flexor retinaculum and hook of the Hamate should be easily felt with the synovial dissector. These landmarks are mandatory to ensure the correct potential space. The ulnar tunnel lacks the ridges and its dissection is much more subcutaneous. If these are not apparent, the operator should regroup and start again.
6. In the case of a tight carpal tunnel, the proximal half of the flexor retinaculum can be divided under direct visualization to provide easier access.
7. The device should not pivot off of the course of the fourth ray when pushed against the hook of the Hamate as this can place the common nerve branch to the ring and middle fingers in danger of transection.
8. Complete transection, especially of the distal edge of the ligament, should be ensured by visualization before completion of the procedure.

REFERENCES

1. Bande S, De Smet L, Fabry G. The results of carpal tunnel release: open versus endoscopic technique. J Hand Surg [Br] 1994;19:14-7.
2. Brown RA, Gelberman RH, Seiler JG, et al. Carpal tunnel release. A prospective, randomized assessment of open and endoscopic methods. J Bone Joint Surg Am 1993;75:1265-75.
3. Worseg AP, Kuzbari R, Korak K, et al. Endoscopic carpal tunnel release using a single-portal system. Br J Plast Surg 1996;49:1-10.
4. Agee JM, McCarroll HR Jr, Tortosa RD, Berry DA, Szabo RM, Peimer CA. Endoscopic release of the carpal tunnel: a randomized prospective multicenter study. J Hand Surg [Am] 1992;17:987-95.
5. Palmer DH, Paulson JC, Lane-Larsen CL, Peulin VK, Olson JD. Endoscopic carpal tunnel release: a comparison of two techniques with open release. Arthroscopy 1993;9:498-508.
6. Erdmann MW. Endoscopic carpal tunnel decompression. J Hand Surg [Br] 1994;19:5-13.
7. Mackenzie DJ, Hainer R, Wheatley MJ. Early recovery after endoscopic vs. short-incision open carpal tunnel release. Ann Plast Surg 2000;44:601-4.
8. Kerr CD, Gittins ME, Sybert DR. Endoscopic versus open carpal tunnel release: Clinical results. Arthroscopy 1994;10:266-9.
9. Jacobsen MB, Rahme H. A prospective, randomized study with an independent observer comparing open carpal tunnel release with endoscopic carpal tunnel release. J Hand Surg [Br] 1996;21:202-4.
10. Haupt WF, Wintzer G, Schop A, Löttgen J, Pawlik G. Long-term results of carpal tunnel decompression. Assessment of 60 cases. J Hand Surg [Br] 1993;18:471-4.
11. Nancollas MP, Peimer CA, Wheeler DR, Sherwin FS. Long-term results of carpal tunnel release. J Hand Surg [Br] 1995;20:470-4.
12. Erhard L, Ozalp T, Citron N, Foucher G. Carpal tunnel release by the Agee endoscopic technique. Results at 4 year follow-up. J Hand Surg [Br] 1999;24:583-5.
13. Murphy RX Jr, Jennings JF, Wukich DK. Major neurovascular complications of endoscopic carpal tunnel release. J Hand Surg [Am] 1994;19:114-8.
14. Feinstein PA. Endoscopic carpal tunnel release in a community-based series. J Hand Surg [Am] 1993;18:451-4.
15. Kelly CP, Pulisetti D, Jamieson AM. Early experience with endoscopic carpal tunnel release. J Hand Surg [Br] 1994;19:18-21.
16. Vartimidis SE, Herndon JH, Sotereanos DG. Failed endoscopic carpal tunnel release. Operative findings and results of open revision surgery. J Hand Surg [Br] 1999;24:465-7.
17. De Smet L, G Fabry G. Transection of the motor branch of the ulnar nerve as a complication of two-portal endoscopic carpal tunnel release: A case report. J Hand Surg [Am] 1995;20:18-9.
18. Skoff HD, Sklar R. Endoscopic median nerve decompression: Early experience. Plas Reconstr Surg 1994;94:691-4.
19. Nagle DJ, Fischer TJ, Harris GD, et al. A multicenter prospective review of 640 endoscopic carpal tunnel releases using the transbursal and extrabursal Chow techniques. Arthroscopy 1996;12:139-43.
20. Rowland EB, Kleinert JM. Endoscopic carpal-tunnel release in cadavera. An investigation of the results of twelve surgeons with this training model. Bone Joint Surg Am 1994;76:266-8.
21. Lee DH, Masear VR, Meyer RD, Stevens DM, Colgin S. Endoscopic carpal tunnel release: A cadaveric study. J Hand Surg [Am] 1992;17:1003-8.
22. Seiler JG, Barnes K, Gelberman RH, Chalidapong P. Endoscopic carpal tunnel release: An anatomic study of the two-incision method in human cadavers. J Hand Surg 1992;17:996-1002.
23. Kuschner SH, Brien WW, Johnson D, Gellman H. Complications associated with carpal tunnel release. Orthop Rev 1991;20:346-52.
24. MacDonald RI, Lichtman DM, Hanlon JJ, Wilson JN. Complications of surgical release for carpal tunnel syndrome. J Hand Surg [Am] 1978;3:70-6.
25. Palmer AK, Toivonen DA. Complications of endoscopic and open carpal tunnel release. J Hand Surg [Am] 1999;24:561-5.
26. Boeckstyns ME, Sørensen AI. Does endoscopic carpal tunnel release have a higher rate of complications than open carpal tunnel release? An analysis of published series. J Hand Surg [Br] 1999;24:9-15.