Single portal endoscopic carpal tunnel release: modification of Menon's technique and data from 65 cases

Alvin Chao-Yu Chen · Meng-Huang Wu ·
Chung-Hsun Chang · Chun-Ying Cheng · Kuo-Yau Hsu

Received: 20 January 2010 / Revised: 6 April 2010 / Accepted: 7 April 2010 / Published online: 5 May 2010
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Abstract The purpose of our study is to make a follow-up evaluation of endoscopic carpal tunnel release under focal anesthesia using the Wolf single portal system. A total of 65 patients with a mean age of 50 years undergoing 79 procedures were retrospectively studied. Preoperative complaints, intraoperative findings, and postoperative results of all the patients were recorded. Follow-up was conducted at 1, 5, 12, and 24 weeks and at 1 year postoperatively. Wound pain, analysis of satisfaction, Levine functional status scales, and surgical complications were included. No patients sustained iatrogenic neurovascular injury or hematoma formation. The average Levine functional severity score decreased from 2.82 points preoperatively to 1.2 points at the most recent survey. One case recurred at 1 year after the surgery and subsequently underwent open release. Surgery using the Wolf single portal system under focal anesthesia is a safe and efficacious option for endoscopic carpal tunnel release.

Introduction

Carpal tunnel syndrome (CTS) is the most frequently encountered nerve entrapment syndrome. Several different

approaches are available for the surgical release of the transverse carpal ligament. The first reports describing endoscopic carpal tunnel release (ECTR) were published in 1989 [7, 17]. Subsequent studies indicated that ECTR resulted in faster recovery with diminished postoperative pain and better cosmesis [1, 3, 8, 11, 19, 22]. Many kinds of instrumentation and release kits have been designed on the basis of these two methods. In 1993, Menon proposed a different proximal single portal system for sectioning of the transverse carpal ligament (TCL) using a beaver blade through a plastic slotted cannula [14]. Despite the encouraging results of proximal single portal ECTR in some studies [6, 18], difficulties in the technique and serious neurological complications including major nerve and digital nerve injuries in proximal single portal ECTR have been reported [5, 21]. Modification of surgical techniques and instruments has continued to evolve, aiming to avoid complications and improve outcome [4, 20].

This study reports our experience in proximal single portal ECTR using the Wolf single portal system describing patient satisfaction, functional results, and surgical complications. We propose that a new modification of an original technique through focal perineural anaesthesia is a reliable and efficient option for ECTR.

Electronic supplementary material The online version of this article (doi:10.1007/s00264-010-1022-8) contains supplementary material, which is available to authorized users.

A. Chao-Yu Chen (✉) · C.-H. Chang · C.-Y. Cheng · K.-Y. Hsu
Department of Orthopaedic Surgery,
Chang-Gung Memorial Hospital & University,
Taipei, Taiwan
e-mail: alvinchen@adm.cgmh.org.tw

M.-H. Wu
Department of Orthopaedic Surgery,
Chang Gung Memorial Hospital at Chia-Yi,
Chia-Yi, Taiwan

Patients, materials, and methods

From 2003 through 2007, a total of 110 patients who were diagnosed as having carpal tunnel syndrome underwent surgical decompression, of which 67 patients had single portal ECTR and 43 had open release under local anaesthesia in an outpatient intervention by a single surgeon. Preoperatively, all the patients were well informed and presented with selection options of both endoscopic and open surgery. One patient had a history

Table 1 Demographic data of patient characteristics

Patients and presentations		Value	Number of hands
Gender	Female	51 (78%)	63 (80%)
	Male	14 (22%)	16 (20%)
Age	Mean	50.2 years	
	Range	32–74 years	
Hands with symptoms/signs	Mean duration	13 months (range, 6–84)	
	Tinel's sign		48 (61%)
	Phalen's sign		50 (63%)
	Durkan's test		65 (82%)
	Nocturnal pain		74 (94%)
	Thenar atrophy		10 (13%)

of ipsilateral distal radius fracture and one had rheumatoid arthritis; both were excluded from the study. A total of 65 patients with 79 affected palms (right hand involvement in 30 patients; left hand, 35; bilateral, 14) that underwent single portal ECTR surgery were included in this study (Table 1). There were 51 female patients (63 hands) and 14 male patients (16 hands) with a mean age of 50.2 years (range, 32–74). All experienced neurological symptoms for more than six months prior to the operation (average, 13 months; range, six months to seven years) and failed to respond to nonsurgical treatment, including activity modification, medication, and therapeutic use of a wrist brace, for more than six weeks. Diagnosis was based on clinical symptoms of pain, numbness, nocturnal paraesthesia in the distribution of the median nerve of the hand, and/or thenar muscle atrophy. Tinel's sign, Phalen's provocative test, and Durkan's compression test were used to support the diagnosis. Electromyography and nerve conduction velocity studies were carried out to clarify the coexisting cervical radiculopathy or to exclude other peripheral neuropathy.

Before surgery, 5 mL 1% lidocaine was administered subcutaneously at the intersecting point of the proximal wrist crease and ulnar side of palmaris longus where a subsequent skin incision was made and extended about 1 cm ulnarly and deeply beneath the palmar fascia for perineural infiltration to minimise the intraoperative discomfort caused by instrumentation. A pneumatic tourniquet on the upper arm was inflated (to 200 mm Hg) just before endoscopy to prevent intraoperative bleeding. Endoscopic carpal tunnel release was conducted using Wolf single portal system (Richard Wolf GmbH, Knittlingen, Germany; Fig. 1). The Wolf release kit consisted of a grip handle and disposable angular blade to facilitate secure control by keeping the blade in the slot of the cannula and avoiding over-the-top release (Fig. 1). Under endoscopic supervision, the entire TCL was clearly visible (Fig. 2) and it was antegradely incised with the angular knife until the TCL

was completely released (Fig. 3). The entire procedure was performed under direct video monitoring. The patient was instructed to maintain regular motion of the hands and fingers; however, excessive stretching or vigorous activity

Fig. 1 **a.** Instruments of the Wolf single portal system included a 2.7-mm 25° endoscope (S), handle, 5.7/7.0-mm slotted cannula (C), angular knife assembly (N), and a right angle probe. **b.** Set-up of the Wolf single portal system with the assistant's hand (H) holding the retractor (R), which is aiming at the radial border of the ring finger and serves as guidance for advancement of releasing knife (N)

Fig. 2 Intraoperative photograph illustrates the endoscopic view of the carpal tunnel with transverse carpal ligament (T) visible at the top before release. The median nerve is beneath the endoscope cannula (C)

of the wrist joint was not allowed until three months after the operation. No splints were used postoperatively.

Regular postoperative follow-up was conducted at one, five, 12, and 24 weeks and at least one year after the operation. Outcome assessment was conducted using a self-administered questionnaire designed by Levine et al. [13]. Levine's functional severity scale contained eight multiple-choice questions with the handicap scoring from 1

Fig. 3 a. Intraoperative photograph. The transverse carpal ligament (T) is released by antegrade cutting with an angular blade (N). **b.** Intraoperative photograph. Complete release of the transverse carpal ligament (T) is confirmed under direct video monitoring

Table 2 Patient outcome

Parameter	Value
Levine functional score	Preoperative 2.82 ± 1.45^a Final survey 1.20 ± 0.79
Nocturnal pain resolution	100% (79/79) ^b
Satisfaction rate	91% (72/79)
Recurrence rate	1% (1/79)

^a Expressed as mean $\pm$ standard deviation

^b Preoperative nocturnal symptoms were noted in 25 patients

(representing no difficulty in activity) to 5 (representing complete disability). The overall score for each scale was calculated by dividing the total by the number of items. Satisfaction scores ranged from 1 (completely unsatisfied) to 5 (very satisfied). The overall satisfaction rate was calculated by dividing the number of patients who were scored as 4 and 5 over the total patient number.

Results

A total of 65 patients continued with the follow-up with the most recent telephone contact for functional survey at an average of 105 weeks (range, 83–153 weeks). The functional results and complication rate are summarised in Table 2. All 79 hands (94%) with disabling nocturnal symptoms reported significant improvement as early as the first postoperative visit. The average score for Levine's functional severity scale reduced from preoperatively 2.82 ± 1.45 points to a final 1.2 ± 0.79 points (Table 3). Sixteen hands (20%) in 14 patients had only minimal numbness over the fingertips. None of the

Table 3 Levine's function severity score [13]

Functional severity scale ^a	Preoperative		Final survey ^b	
	Mean	SD	Mean	SD
Writing	2.26	1.35	1.22	0.80
Buttoning clothes	3.04	1.63	1.15	0.77
Holding a book while reading	2.85	1.46	1.15	0.77
Gripping a telephone handset	3.04	1.40	1.15	0.77
Opening jars	2.93	1.36	1.30	0.87
Household chores	2.78	1.50	1.15	0.77
Carrying grocery bags	3.07	1.41	1.33	0.83
Bathing and dressing	2.56	1.50	1.50	0.77
Average	2.82	1.45	1.20	0.79

SD Standard deviation

^a The functional severity is scaled from 1 (no difficulty) to 5 (complete disability)

^b Functional status at final survey

patients developed any major complications such as damage to the superficial arteriovenous arch or major nerve injury. The minimal skin incision eventually faded into the skin crease after a few weeks. None of the patients experienced infection, wound problems, or scar hypertrophy. One patient (one hand, 1%) had recurrent symptoms after one year and subsequently received open surgery. The overall satisfaction rate was 91%.

Although we did not include a control group in the clinical study, data of functional survey were available in 16 patients (20 hands) out of 43 patients (53 hands) undergoing OCTR under the same anaesthesia method. The average Levine's functional severity scale improved from preoperative 2.78 ± 1.38 (range, 2.35–3.04) to postoperative 1.23 ± 0.78 (range, 1.51–1.15). There was no wound problem, no major nerve complication and no case of recurrence. Overall satisfaction rate in those patients (OCTR group) was 90.2%. Comparing the results of the ECTR group and the OCTR group, no significant difference could be found in the Levine's functional severity scale, complication/recurrence rate and satisfaction rate.

Discussion

Despite the controversy over open versus endoscopic surgery, many clinical studies have indicated that the latter results in lower postoperative pain and a quicker functional recovery time than the former, making it more helpful to resume normal life activities [3, 11]. Nevertheless, ECTR surgery has still been reported to have many complications including superficial palmar arch, ulnar neurovascular, median nerve, and common digital nerve injuries, and the incidence of postoperative median nerve neuropraxia has been reported [4, 13, 21]. Menon et al. [14] introduced an antegrade single portal technique and Tuzuner et al. [20] modified Menon's procedure. Both reported fewer complications and left no distal exit portal morbidity. However, higher incidence of transient median nerve neuropraxia was reported and varied from 4% to 31% [7, 14, 15]. Tuzuner et al. also observed abnormal sensations (5.7%) caused by Menon's procedure with higher incidence in the 4.0-mm scope group than in the 2.7-mm scope group [6]. In our experience, there are three additional reasons that could explain the better results obtained with the modified Menon procedure by using the Wolf single portal system. First, the incision was made directly on the proximal wrist crease and was ulnar to the palmaris longus to avoid cutaneous nerve injury [12]. Second, sequential dilatation of the tunnel tract to a lesser extent can avoid median nerve injury [5]. Third, the curved knife with a disposable beaver blade facilitated steady control and secure release along the slotted cannula. Reckless extrusion of the beaver blade was thus prevented to avoid

jeopardising surrounding neurovascular structures. Besides, most of our procedures were conducted under local anaesthesia where only sensory nerve was blocked. The patients were conscious and sensitive throughout the surgical procedure and were allowed to move their fingers immediately after surgery. We believe that induction of simple anaesthesia and fast resumption could be conducive to patient's satisfaction and reduction in perioperative anxiety.

To prevent recurrent symptoms, the TCL must be cut through completely [16, 23] under endoscopic view with complete escape of palmar fat, and requires verification by the probe after release. The angular knife in the Wolf device was designed to facilitate better control than the hook knife, and facilitated an easier approach and release of any portion of the TCL. In addition, the slotted cannula was designed to serve as a straight cutting guide and to allow a clear view of the carpal tunnel.

Approximately 94% of our patients suffered from severe nocturnal pain and paresthesia, and 82% had positive Durkan's compression test. All these patients reported immediate resolution postoperatively. Although electrophysiology examination was also included in the preoperative survey, its use postoperative assessment was neither regularly performed nor used to monitor functional recovery. Therefore, we believe that nocturnal symptoms and Durkan's test not only serve as valuable surgical criteria alone but can also be considered as the most sensitive prognostic factors. Many other postoperative parameters also correlated with the final results, and methods to evaluate the success of this procedure are currently being studied [2, 9, 10]. The Levine functional status scale used in our study contains multiple-choice questionnaires, which are closely related to daily performance and are easily applicable to the general population. The differences between the preoperative handicap and postoperative performance determine the treatment outcome and patient satisfaction.

Despite many objective data and the subjective impressions from patients' experiences that enthusiastically support the superiority of the endoscopic approach, it is still unclear as to whether the endoscopic approach exposes patients to excessive and potentially unnecessary risks. Therefore, we performed endoscopic surgery under local anaesthesia. In order to avoid intraoperative discomfort during instrumentation, perineural infiltration with lidocaine was performed before surgical intervention. No patient was switched to open surgery during the operation, one patient (1%) in our series experienced recurrent symptoms at one year and subsequently underwent open surgery. During the second operation, the TCL was found to be severely scarred with the median nerve tightly entrapped. The patient had satisfactory results after the open surgery and no more recurrence in this survey.

The major limitation in this study concerns the small sample size and lack of a control group against whom

statistical differences could be established. Nevertheless, our observational data have demonstrated encouraging results with high satisfaction (91%) and low complication rate (1%). Long-term follow-up studies with ongoing investigation are required to establish the optimum approach on this disease entity.

Conclusion

The observational data in our study have demonstrated encouraging results. We conclude that endoscopic release under local perineural anaesthesia using the Wolf single portal system serves as a safe and efficacious option for endoscopic carpal tunnel release.

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