Trauma Mon. 2014 November; 19(4): e18058. DOI: 10.5812/traumamon.18058

Published online 2014 September 10. **Research Article**

Endoscopic Carpal Tunnel Release: A 5-Year Experience

Shahram Nazerani [1,2,*]; Mohamad Hossein Kalantar Motamedi [3]; Tina Nazerani [1]; Amir Saraii [1]; Mohamad Reza Keramati [4]

[1]Department of Surgery, Firuzgar Medical Center, Iran University of Medical Sciences, Tehran, IR Iran
[2]Department of Hand Surgery, Mehr Genrel Hospital, Tehran, IR Iran
[3]Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran
[4]Department of Surgery, Imam Khomeini Medical Center, Tehran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Shahram Nazerani, Department of Surgery, Firuzgar Medical Center, Iran University of Medical Sciences, Vali-Asr Sq., Behafarin St., Tehran, IR Iran. Tel: +98-9121112216, Fax: +98-2122569149, E-mail: snazerani@yahoo.com

Received: February 5, 2014; **Revised:** February 28, 2014; **Accepted:** May 2, 2014

Background: Endoscopic carpal tunnel release (ECTR) has gained recognition as an alternative to the current gold standard, the open carpal tunnel release (OCTR). Detailed technical points for the ECTR have not been explained in the literature, especially for surgeons who are considering trying this technique.
Objectives: In this paper, we present our 5-year experience with the ECTR and special emphasis will be placed on less frequently discussed technical points, such as the optimal site to make the skin incision and the signs to look for in a completely divided retinaculum.
Patients and Methods: In this prospective nonrandomized clinical trial, 176 patients with carpal tunnel syndrome who underwent surgical operation using the Agee uni-portal endoscopic carpal tunnel release technique, over a period of 5 years, were included. The "Hand Questionnaire", a standard questionnaire for hand surgery, was used to evaluate the patients at one, three, six and twelve month post-operative time points. Pain and scar tenderness were measured using the visual analog scale system. We propose the 'most proximally present wrist crease' for the skin incision and the 'proximal to distal sequential division of the retinaculum' as our methods of choice. Two signs, named 'railroad' and 'drop in', are proposed and these will be discussed in detail as hallmarks of complete retinaculum release.
Results: Of the 176 patients who underwent the ECTR operation, 164 cases (93.2%) had no or very little pain at the one year postoperative visit, and nearly all of the patients reported no relapse of symptoms at the previously mentioned postoperative time points. Patient satisfaction and functional recovery was comparable to other published ECTR studies, and showed better short-term results of this technique over the OCTR. One deep seated infection, three cases of transient index finger paresthesia due to scope pressure on the median nerve, and one case of median nerve branch transection, were observed. Scar complications, including; tenderness, redness and pain, were significantly lower in the proximally placed incision in comparison with the distally placed incision ($P < 0.005$).
Conclusions: The 'most proximally present wrist crease' and the 'distal to proximal division of the retinaculum' using the two signs of 'railroad' and 'drop in' to confirm a complete division of retinaculum are proposed techniques that should be considered in order to produce good outcomes in ECTR. The 'railroad' sign is the parallel standing of the retinaculum edges, and the 'drop in' sign is the dropping of the retinaculum edge into the scope denote a completely divided retinaculum.

Keywords: Carpal Tunnel Syndrome; Endoscopy; Nerve Compression Syndromes; Median Nerve

1. Background

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the upper limb, and carpal tunnel surgery makes up a considerable portion of the operations of hand surgeons (1, 2). Although the long-term outcomes of open carpal tunnel release (OCTR) and endoscopic carpal tunnel release (ECTR) are both excellent, the trend in all branches of surgery is towards a minimally invasive approach, thus methods such as ECTR are gaining popularity (3). Based on our review of the literature, we noticed that there are a number of ECTR papers with large groups of patients presenting outcomes of their cases, but they lack in-depth technical points about the surgical technique.

2. Objectives

In this article, we present our experience with one portal endoscopic carpal tunnel surgery, with special emphasis on the technical points, including the location of the skin incision and the signs of a completely divided retinaculum.

3. Patients and Methods

In this prospective nonrandomized clinical trial conducted from January 2007 to January 2012, a total of 176 patients with CTS, who were operated on by the endoscopic method, were enrolled. This study was approved by the Ethics Committee of both Firuzgar Medical Center and Mehr General Hospital. Data were extracted from

patient records using a standard questionnaire and included: demographics, subjective complaints on presentation, history of prior interventions, physical examination findings, results of nerve conduction studies, and follow-up data. Extracted demographic data included: gender, race, hand dominance, age and medical comorbidities. Subjective complaints included: symptomatic side, weakness, pain, clumsiness, tingling, awakening from sleep by symptoms, exacerbation of symptoms by driving, and duration of symptoms, were also collected.

Patients were asked about prior interventions, such as; corticosteroid injections, splinting, prior surgery, use of nonsteroidal anti-inflammatory drugs and/or vitamin B6, physical therapy and work modifications. Physical examination data included: the presence or absence of thenar atrophy, Tinel's sign, Phalen's sign, and a positive median nerve compression test. Follow-up data included: time to final follow-up, postoperative pain, scar tenderness, grip strength and complications.

Patients were given an explanation about the technique, the two available surgical options, pros and cons of each method, and their postoperative short-term and long-term complications. Each patient had the opportunity to select his/her surgical technique based on the information provided. Since the price of the MicroAire (Charlottesville, VA, USA) disposable blade is not covered by insurance companies in our country, its price was one of the deciding factors. The length of scar and tenderness in OCTR was another deciding factor in favor of ECTR. Written consent was also obtained from each patient (Table 1).

the Hand Questionnaire was completed before the surgery and at one, three, six and twelve months following the operation, and the physical examinations were also repeated. Pain was measured using visual analog scale (VAS, a scale of 0 to 10). The grip strength was measured with a Jamar Dynamometer (Sammons Preston Rolyan, IL, USA). The scar tenderness evaluation was done using VAS, and the patients marked how painful they thought the scar was on a scale of four degrees, from no pain to very painful.

Data were analyzed using SPSS software (Statistical Package for Social Sciences) version 16 for Windows (SPSS Inc., Chicago, Illinois). An independent Student's t-test was used to compare the parametric variables between the two groups, and a Chi-square test was also used. Mean data are represented as the mean ± SD. P values less than 0.05 were considered significant.

3.1. Skin Incision

The Agee uni-portal endoscopic carpal tunnel system (Micro-Aire Surgical Instruments, Charlottesville, Va.) was used. The company's website depicts an incision over the distal wrist crease, and we were also trained to place the incision over the distal wrist crease. Therefore, the first 50 cases that we operated on had an incision over the distal wrist crease; however, we observed that the scar at this site remained tender and that the redness remained for a longer period of time than was expected, sometimes more than six months (Figure 1).

In the remaining 126 patients, we changed the location of the incision to the most proximally present crease. Since the distal wrist crease is the pivot point of wrist movement, it is prone to the repeated traumas of daily life. We observed that these proximally located scars, in addition to being cosmetically more acceptable, were less problematic for the patient (Figure 2).

Table 1. Demographic and Clinical Characteristics of Patients Who Underwent ECTR [a]

Variable	Result (n = 176)
Age, y	48 ± 14
Gender	
Male	15 (8.5)
Female	161 (91.5)
Body Mass Index, kg/m²	27.5 ± 4.5
Duration of symptoms, d	36 ± 19
Hypertension	
Yes	18 (10.2)
No	158 (89.8)
Diabetes Mellitus	
Yes	16 (9)
No	160 (91)
Hypothyroidism	
Yes	20 (11.3)
No	156 (88.7)
Smoking	
Yes	15 (8.5)
No	161 (91.5)
Nerve Conduction Studies	
Distal motor latency, millisecond	5.7 ± 1.4
Distal sensory latency, millisecond	4.6 ± 1.1
Sensory conduction velocity in carpal tunnel segment, M/Hr	17 ± 12

[a] Data are presented as mean ± SD or No. (%).

Figure 1. Patient With a Distal Wrist Crease Incision, Six Months After the Operation the Scar is Still Red and Tender.

Figure 2. Patient With the Incision Placed Over the Proximal Wrist Crease. A non-tender scar is the strong point of this incision.

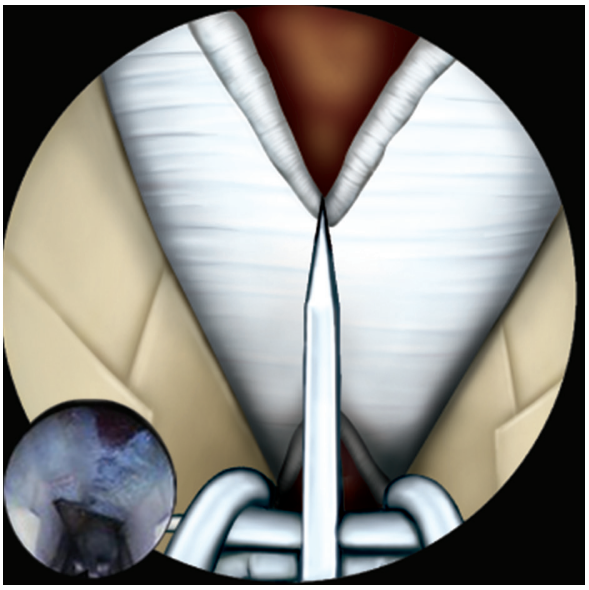

Figure 3. Schematic Drawing of the Sequential Division of the Retinaculum in a Proximal to Distal Direction (Actual Image at the Bottom Left Corner).

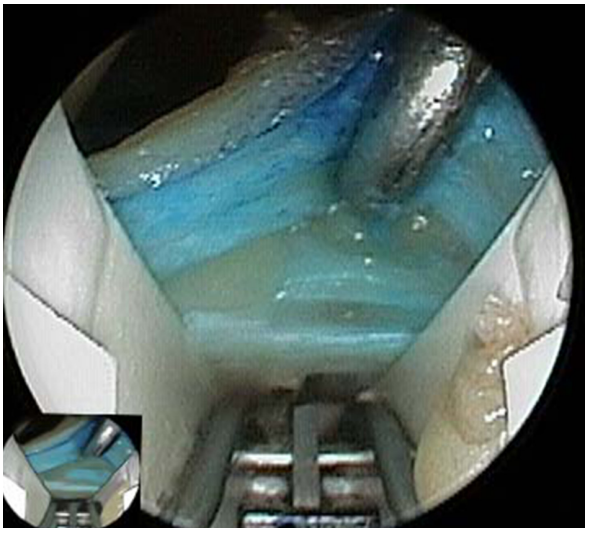

Figure 4. Actual Image Showing how the Assistant Retracts the Skin Upward When the Blade Emerges from the Incision to Prevent an Inadvertent Vertical Cut of the Skin (Schematic drawing at the Bottom Left Corner).

3.2. Retinaculum Transection

We start the transection of the retinaculum in a proximal to distal direction. The proximal to distal division has the advantage of protecting the distally located median nerve branches from inadvertent injury by the gradual widening of the tunnel through a proximal division (Figure 3).

Another important technical point needs to be considered during the transection of the retinaculum. At the end of the transection, when the blade approaches the wrist skin incision, the assistant should lift the skin with a hook so that the emerging blade does not cut the skin vertically (Figure 4).

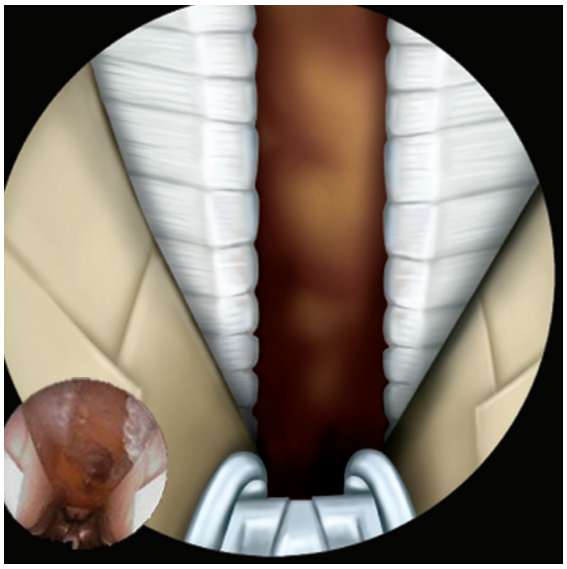

Figure 5. A Schematic Drawing Showing the Railroad Sign. The edges of the retinaculum are retracted and standing parallel to the edges of the scope (actual image at the bottom left corner).

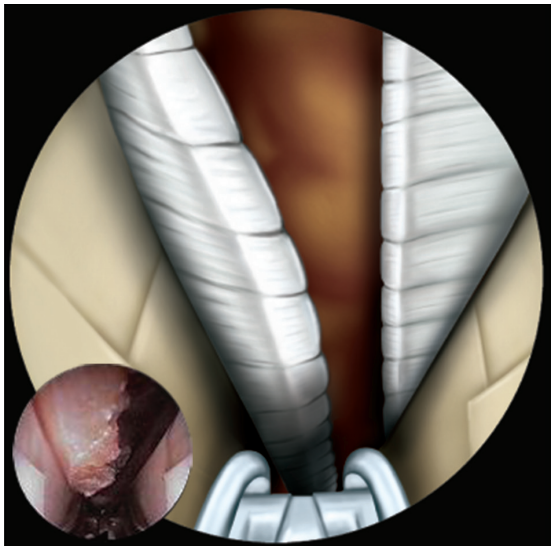

Figure 6. A Schematic Drawing Showing the 'Drop-In' Sign. The retinaculum is completely transected and drops into the scope (actual image at the bottom left corner).

3.3. Signs of Complete Retinaculum Transection

To ensure complete division of the retinaculum we observe two signs, the 'railroad' and 'drop-in' signs. The 'railroad' sign denotes the parallel position of the divided retinaculum seen through the scope. This parallel standing of the retinaculum (railroad sign) has previously been mentioned by Luria et al., but without assigning a specific name to it (4) (Figure 5).

The 'drop-in' sign refers to the falling of the retinaculum edges into the scope, when the scope is turned sideways. In our experience this sign is a very important observation, because only the completely divided retinaculum falls into the scope (Figure 6).

4. Results

The degree of pain relief and remission of symptoms at the one year postoperative time point clearly shows a significant relief of pain and remission results (Table 2). About 93.8% of patients (164 cases) had no or very little pain. 92% of patients (162 cases) reported complete remission of symptoms from a range of paresthesia to pain and 8% (14 cases) had some recurrence of symptoms, which was usually temporary, especially in the colder months of the year. Scar complications such as tenderness, redness and pain in the proximally placed incisions were lower, 15 % in proximally placed incisions versus 28% in distally placed incisions, when compared to the distally placed incisions ($P < 0.005$).

The patients returned to light-duty work after an average of 18 days, from 14 to 24 days. Of the 120, 68% of total group, for whom postoperative work status was available, 108 cases (90%) were able to return to their original occupation. There was one case of a median nerve branch transection which was converted to an open surgery. Three cases of transient index finger paresthesia were observed; the paresthesia resolved in nearly all cases three months after the operation. Pillar pain was recorded in 20 patients; this is a self-limited complication seen in most patients at the three month postoperative point. One case of deep seated infection with inflammation and tenderness was treated successfully by antibiotics.

Table 2. Postoperative Parameters of ECTR at the One Year Postoperative Point [a,b]

Postoperative Variables	Values (n = 176)
Pain relief (VAS scale 0-10)	
0-3	164 (93.2)
4-6	12 (6.8)
7-10	0
Remission of symptoms (% of patient satisfaction)	
100%	162 (92)
75-99%	12 (6.8)
0-74%	2 (1.2)

[a] Abbreviation: VAS, visual analog scale.
[b] Data are presented as No. (%).

5. Discussion

ECTR is considered to be a new alternative to OCTR and only 10% of carpal tunnel surgeries in the United States use the endoscopic method. In developing countries, the price of the instruments and disposable blades make this operation a less attractive option for patients. In our country in spite of the financial problems, the numbers of patients who are enthusiastic to have their operation using this modality are higher than expected, and the awareness of the general public and acceptance of this operation has increased during the past few years.

Kang et al. performed ECTR and OCTR simultaneously in patients with bilateral disease and compared the results. They determined that the majority of patients preferred ECTR over OCTR (5). They concluded that good clinical outcomes and patient satisfaction are achieved more quickly with the endoscopic method of carpal tunnel release. While the opponents of ECTR point to the cost effectiveness and complications. A literature review by Benson et al. yielded 22327 cases of endoscopic carpal tunnel release and 5669 cases of open carpal tunnel release. The study showed that the incidence of structural damage to nerves, arteries, or tendons, for open carpal tunnel release is 0.49%, and for endoscopic methods it is 0.19% (6).

Regarding the cost effectiveness of ECTR over OCTR, Saw et al. recommended that endoscopic carpal tunnel release should be considered as a cost-effective procedure, but perhaps should not be recommended in the general population as a whole (7). Thoma et al. reported a one-way sensitivity analysis in their study, demonstrating that when both OCTR and ECTR are performed in a day surgery unit, the incremental cost utility ratio (ICUR) falls in the 'win-win' quadrant, making ECTR more effective and less expensive than OCTR (8).

On one hand, the currently published ECTR articles focus mainly on the results and its comparison with OCTR, but the technical points have not been extensively discussed in the ECTR literature. On the other hand, a novice surgeon or someone interested in starting ECTR needs to know more detailed surgical techniques. Smith et al. proposed dilation of the canal for better passage of the scope (9). Uchiyama et al. presented technical difficulties encountered while passing the scope. They proposed dilation of the canal prior to passing the scope (10). According to our review of the literature, we found no articles on the choice of location for the incision, while the Micro-Aire Company has suggested an incision near the distal wrist crease.

We propose that the skin incision be placed on the most proximal wrist crease. Moreover, an incremental proximal to distal directed division of the retinaculum is suggested. The surgeon should look for the 'railroad' and 'drop in' signs, which are the hallmarks of a complete retinaculum division. The 'drop in' sign seems to be the most important indicator. The skin should be lifted while the blade emerges into the incision to prevent inadvertent extension of the incision. This study is in agreement

with previously published literature and shows that ECTR is moderately superior to OCTR in the short-term follow-up period (7, 11-13).

Acknowledgements

The authors wish to thank A. Saraii M.D for sketching the images of endoscopic surgery.

Authors' Contributions

Study concept and design: Shahram Nazerani; analysis and interpretation of data: Mohamad Reza Keramati; drafting of the manuscript: Tina Nazerani; critical revision of the manuscript for important intellectual content: Mohammad Hosein Kalantar Motamedi; statistical analysis: Amir Saraii and Mohamad Reza Keramati.

References

1. Lo SL, Raskin K, Lester H, Lester B. Carpal tunnel syndrome: a historical perspective. *Hand Clin.* 2002;**18**(2):211–7.
2. Green DP, Pederson WC, Hotchkiss RN, Wolfe SW. *Greens Operative Hand Surgery.* 5th ed. Philadelphia: Elsevier Churchill Livingstone; 2005. pp. 1009–18.
3. Sabesan VJ, Pedrotty D, Urbaniak JR, Aldridge JM, 3rd. An evidence-based review of a single surgeon's experience with endoscopic carpal tunnel release. *J Surg Orthop Adv.* 2012;**21**(3):117–21.
4. Luria S, Waitayawinyu T, Trumble TE. Endoscopic revision of carpal tunnel release. *Plast Reconstr Surg.* 2008;**121**(6):2029–34.
5. Kang HJ, Koh IH, Lee TJ, Choi YR. Endoscopic carpal tunnel release is preferred over mini-open despite similar outcome: a randomized trial. *Clin Orthop Relat Res.* 2013;**471**(5):1548–54.
6. Benson LS, Bare AA, Nagle DJ, Harder VS, Williams CS, Visotsky JL. Complications of endoscopic and open carpal tunnel release. *Arthroscopy.* 2006;**22**(9):919–24.
7. Saw NL, Jones S, Shepstone L, Meyer M, Chapman PG, Logan AM. Early outcome and cost-effectiveness of endoscopic versus open carpal tunnel release: a randomized prospective trial. *J Hand Surg Br.* 2003;**28**(5):444–9.
8. Thoma A, Wong VH, Sprague S, Duku E. A cost-utility analysis of open and endoscopic carpal tunnel release. *Can J Plast Surg.* 2006;**14**(1):15–20.
9. Smith AM, Belcher HJ. Endoscopic release of the carpal tunnel: a technical note. *J Hand Surg Br.* 1999;**24**(2):249–50.
10. Uchiyama S, Nakamura K, Itsubo T, Murakami H, Hayashi M, Imaeda T, et al. Technical difficulties and their prediction in 2-portal endoscopic carpal tunnel release for idiopathic carpal tunnel syndrome. *Arthroscopy.* 2013;**29**(5):860–9.
11. Sano K. The Japanese experience with endoscopic carpal tunnel release. *Semin Plast Surg.* 2008;**22**(1):37–41.
12. Thoma A, Veltri K, Haines T, Duku E. A meta-analysis of randomized controlled trials comparing endoscopic and open carpal tunnel decompression. *Plast Reconstr Surg.* 2004;**114**(5):1137–46.
13. Serra L, Panagiotopoulos K, Bucciero A, Mehrabi FK, Pescatore G, Santangelo M, et al. Endoscopic release in carpal tunnel syndrome: analysis of clinical results in 200 cases. *Minim Invasive Neurosurg.* 2003;**46**(1):11–5.