

Wrist

The value of one-portal endoscopic carpal tunnel release: a prospective randomized study

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Abstract. A randomized prospective study was carried out to compare one-portal endoscopic carpal tunnel release with an open procedure. There were 47 patients (mean age 52.6 years); 25 underwent an endoscopic and 22 an open release. The aim of the study was to evaluate the risks against the benefits for pain, grip, key-pinch strength and ability to return to work. The distribution of age, occupation, sex, neurographic findings and operated hand was similar in both groups. We detected no serious nerve complications. One “open” patient developed a hypertrophic scar, a second “open” patient a disabling reflex sympathetic dystrophy, one “endo” patient a transient neurapraxia. The remaining patients experienced complete relief of symptoms. Improvement of grip strength is significantly better after endoscopic release ($P = 0.0001$ at 3 months). In contrast, the key-pinch showed a similar pattern of improvement in both groups. The ability to use the operated hand as effectively as the contralateral one developed after 24 days for the endoscopic group versus 42 for the open approach ($P = 0.0000$). The carpal arch alteration was less important for the endoscopic group ($P = 0.013$), but without any correlation with the grip strength. Agee’s one-portal technique only allows correct placement of a knife, not an inspection of the structures being operated upon. This is a major limitation, reducing the surgeon to a technician. Further development of this procedure demands a device that will enable a fruitful inspection of the carpal tunnel.

Key words: Carpal tunnel – Nerve compression – Open release – Endoscopy

Introduction

The techniques of endoscopic carpal tunnel release described in the literature [1–5, 7, 20] suggest an improved outcome compared with open release. It offers reduced postoperative pain, less scarring and a faster recovery of

the grip and pinching strength, thus enabling a quick return to work. A new training model showed that the risks of complication are real with the two-portal technique [14]; furthermore, some authors [9, 12, 16] report disabling nerve lacerations also for the two-incision method. Therefore, the safety and the benefit of these new techniques remain open to discussion [8] since a major nerve laceration is not only a socioeconomic disaster but a major invalidity.

Materials and methods

The study included 47 patients (mean age 52.6 years), 10 male (mean age 55.7 years) and 37 female (51.7 years). We operated on 25 patients (mean age 48.6 years) endoscopically and on 22 with an open procedure (mean age 57 years). Each patient gave informed consent to enable randomization. The study lasted 8 months. An additional procedure, synovialitis or other concomitant disease (e.g. diabetes or rheumatoid arthritis) excluded the patient from the study. Indications for surgery were based on positive clinical findings (Phalen’s test) and positive neuroconductive findings.

Patients

Nineteen female and 6 male patients had an endoscopic release, and 18 female and 4 male patients, an open release. The mean age and the operated dominant hand (60% endoscopically, 57% open) of both groups were similar. Symptoms were present for an average of 37 weeks in both groups (39 weeks and 35 weeks, respectively). The distribution of occupation, age, sex, delay between the onset of symptoms and surgery (38.8 and 34.5, respectively) was similar in both groups.

All wrists were assessed for a change in carpal arch diameter by means of standardized carpal tunnel views as described by Gartsman et al. [11]. Both preoperative and postoperative films were obtained. The distance was measured between the tip of the trapezial ridge and the tip of the hook of the hamate.

Surgical procedure

Both procedures were done under regional anaesthesia. The open procedure as described by Sennwald [17] allows primary closure of the retinaculum flexorum (Fig. 1). The endoscopic release is done with the endoscopic device developed by Agee (3M Orthopedic Products Division, St. Paul, Minn.). A 2–3 cm skin incision

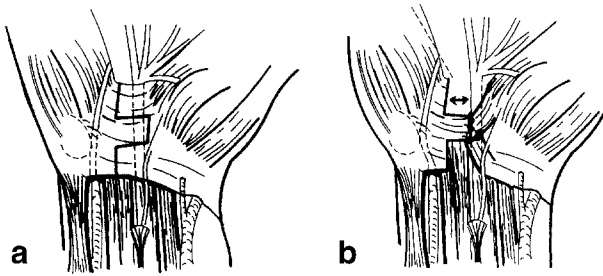


Fig. 1. Technique of widening the carpal tunnel with primary closure

is made 2 cm proximal to the wrist flexion crease between the flexor carpi radialis and flexor carpi ulnaris tendons. The subcutaneous tissue is prepared and the forearm fascia opened with a transverse incision. The median nerve is identified, a flap of the distal forearm fascia is elevated, and a probe is introduced between the median nerve and the dorsal aspect of the transverse carpal ligament. The probe is shifted along the axis of the ring finger, the hand being held in neutral position. Next, the surgeon introduces the blade assembly along the same path, whereby he continuously visualizes the transverse carpal ligament to avoid any possible interposition of nerve or tendons. After identification of the distal edge of the transverse carpal ligament, the device is withdrawn with a gentle upward pressure (but without any digital pressure on the operated hand!) to cut the transverse carpal ligament.

All patients had a tourniquet to provide a bloodless field. The operative time averaged 35 min for the open technique and 15 min for the endoscopic technique. All patients went home the same day with a palmar plaster splint leaving the fingers free for mobilization and normal daily use. At 10 days the splint and sutures were removed.

Follow-up

Grip and pinch strength were measured preoperatively and at 4, 8 and 12 weeks postoperatively. The grip strength was measured in kilograms force, using a Jamar Hand Dynamometer (Clifton, N.J.) on position II. The pinch strength was measured in pounds, using a B & L Engineering device, model PG-30 (Santa Fe Springs, Calif.). The capability to use the operated hand without any restriction defined the aptitude to work. This definition thus does not include the doctors' judgement, employers' pressure or any problems associated with the occupation.

Statistics

Two sample (unpaired) *t*-tests were used to compare the open and endoscopic population. Paired *t*-tests were used to analyse the set of data obtained from the operation and at follow-up for each sample. Since the results were highly influenced by outliers, we confirmed the findings with non-parametric statistical methods (Wilcoxon for paired comparison and Mann and Whitney for testing the difference between the means of the two independent groups) that reduces error due to invalid assumptions. Accordingly, *P* values are given for the non-parametric test. A contingency table analysis (chi-square test) was used to evaluate the distribution of the outcomes. A NCSS program ver (5.X; 1992) was used.

Randomization

A random sample is one in which all members of the population have an equal and independent chance of being selected. After a patient was accepted for the study, the only criterion of choice was

the surgical procedure. We therefore used a lottery-like procedure. Slips, defining the procedure, were drawn at random from a drum by the nurse giving the appointment for surgery.

Results

No serious nerve complications were encountered in either group. In one patient the ligament could not be visualized through the endoscope to allow safe division. The procedure was abandoned, and an open release was performed showing an anomaly of the retinaculum flexorum and also an aberrant ulnar artery. No deep infections or tendon lacerations were noted. No patient required re-operation for incomplete release. One open patient developed a painful hypertrophic scar. A second open patient presented with a reflex sympathetic dystrophy with pain and stiffness of the hand, making it impossible to obtain a postoperative view of the carpal tunnel even at 12 weeks' follow-up. One endo patient presented with a transient neurapraxia (2 weeks) of the common digital nerve to the third web space. The remaining patients claimed complete relief of symptoms.

The outcome for grip strength and key-pinch are shown in Figs. 2 and 3. The grip strength was not different in either group before surgery. Afterwards, it was signifi-

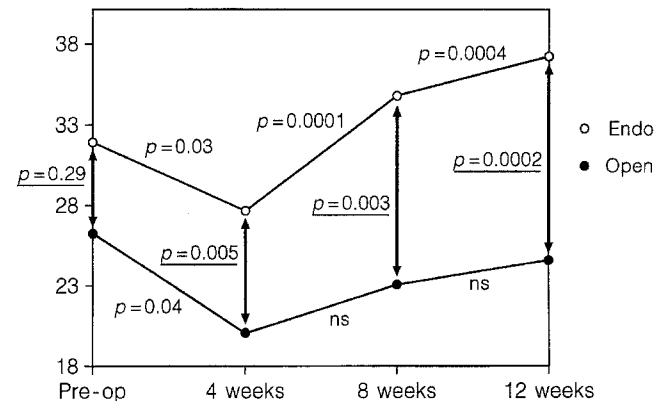


Fig. 2. Recovery of the grip strength is extremely slow after the open procedure; the difference is very significant after 12 weeks

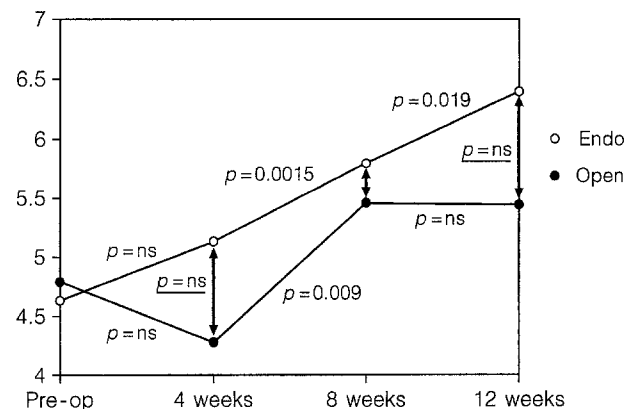


Fig. 3. The key-pinch does better after the open procedure, but without a significant difference between either sample

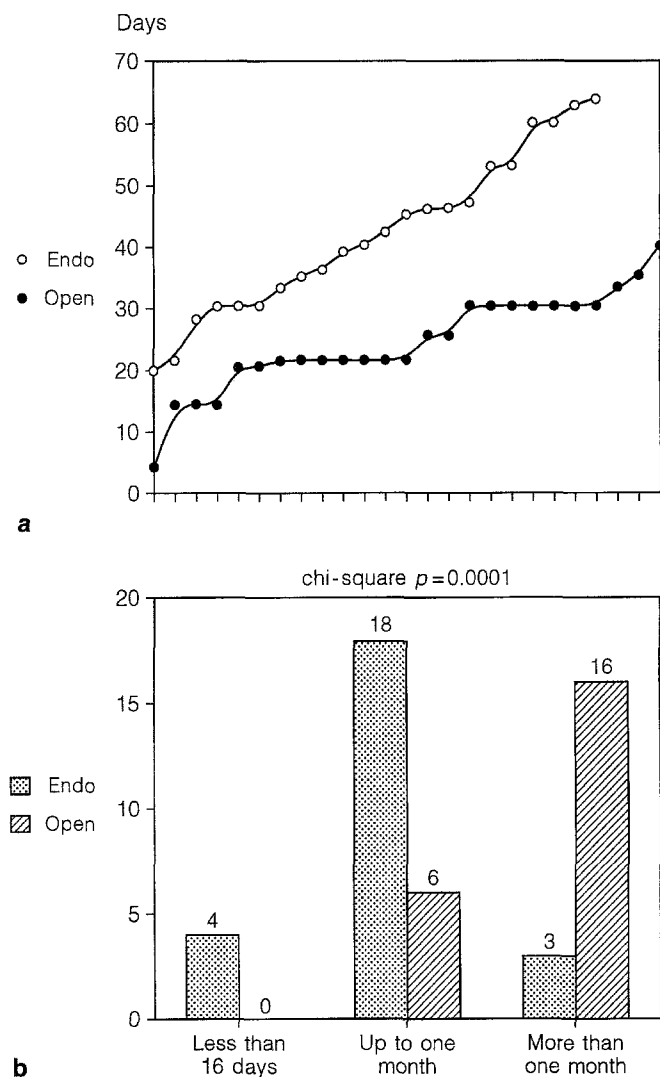


Fig. 4a, b. The time out of work is significantly reduced after endoscopic release as shown by parametric test ($P = 0.0000$; **a**) and chi-square test ($P = 0.0001$; **b**) 88% of the endo population had normal hand function by 1 month

cantly altered in both groups, but recuperation was significant only in the endoscopic group, resulting in a significant difference in the mean strength of both groups at follow-up ($P = 0.0002$). In contrast, the values of the key-pinch remained similar in both groups before and after surgery.

The endoscopic group could use the operated hand normally after 24 days. In contrast, 42 days were necessary after the open procedure, an extremely significant difference ($P = 0.0000$; Fig. 4).

The change in the carpal arch measured from the apex of the palmar ridge of the trapezium to the apex of the hook of the hamate showed a significant ($P = 0.004$) increase for both groups (+ 0.164 cm or + 6.3%). It is less obvious for the endoscopic group (+ 0.144 or + 5.5%) than for the open group (+ 0.187 or + 7.4%), but the mean difference is not statistically significant. However, the widening did not exceed 5% in most of the wrists operated on endoscopically (60%), whereas 75% of the wrists

of the open group had a widening beyond this range. This distribution pattern of widening is significantly different (chi-square test, $P = 0.013$). We found no correlation between grip or pinch strength and widening of the carpal arch.

Discussion

The one-portal technique appears to be safe. We introduced it as a routine procedure in our clinic. Four different surgeons use this technique routinely (one senior surgeon and three residents). Fifty further carpal tunnels have been operated on, and we have observed only two further transient neurapraxia, but no major nerve lacerations. The results remained constant and comparable to the randomized series. We did not observe the so-called learning curve reported for the two-incision method [14, 16]. However, all the surgeons using this new technique had experience with the open procedure.

The two-portal technique is associated with a higher complication rate [12, 14, 16]. This contrasts with the report of Brown et al. [3], who found the two-portal procedure less hazardous. The extension of the hand combined with the placement of the device might induce some strain on the surrounding structures, a fact suggested by the fracture of the hook of the hamate reported by Rowland and Kleinert [14]. Considering that only a few millimeters of space are left between the blade and the neurovascular bundle [9], the ulnar nerve is fixed distally in Guyon's canal [16], and the section line occurs practically along the ulnar neurovascular bundle [6], we believe that it is mandatory to avoid any constraint.

Therefore, we avoid any dorsal extension of the wrist and introduce the 3M device 2 cm more proximal than initially recommended by Agee et al. [1]. Knowing the possible fixation of the ulnar artery in Guyon's canal and the boundaries of Guyon's canal, we direct the blade assembly toward the third web space, the hand being held in a neutral position, and not toward the ring finger as initially described. We also avoid any digital compression on the hand during the section of the carpal ligament.

However, this technique differs from arthroscopic surgery in that it does not allow us to analyse the cause of the pathology nor the structure being treated; its sole purpose is to decrease the postoperative morbidity by placing the knife at the most appropriate place. This absence of direct vision might prevent identification of an anomaly [13, 15, 18, 19], with a potential risk of laceration. This shows that an open procedure is mandatory when poor visualization or some anatomical variation is suspected. Is this enough to avoid further complication in the future? Nevertheless, the one-portal technique offers low risk, low morbidity and quick rehabilitation.

We found no correlation between the carpal arch widening and strength as shown by Gartsman et al. [11]. However, our widening range remained under the 20% limit beyond which strength is reduced in Gartsman's sample. Our widening range is in accordance with the data reported by Viegas et al. [20] or Garcia-Elias et al. [10].

In conclusion, this study is strongly in favour of endoscopic release. However, this technique does not allow any analysis of the pathology or structure to be treated. Has such a blind technical approach any justification? It will increase the number of surgeons treating carpal tunnel syndrome while reducing the information related to the disease. Since the device will not allow exploration inside the tunnel, the risk of an uncontrolled extension of the procedure exists which could lead to a controversy similar to that following some of the drug withdrawals in the last 30 years. It is detrimental for a surgeon to be reduced to just a technician. He or she is responsible for the body of knowledge for the forthcoming generation of surgeons and therefore must use a device enabling a fruitful inspection of the carpal tunnel. This explains why some esteemed hand surgeons have abandoned the procedure [8].

References

- Agee JM, McCarroll HR, Tortosa RD, Berry DA, Szabo RM, Peimer CA (1992) Endoscopic release of the carpal tunnel: a randomized prospective multicenter study. *J Hand Surg [Am]* 17:987–995
- Bande S, De Smet L, Fabry G (1994) The results of carpal tunnel release: open versus endoscopic technique. *J Hand Surg [Br]* 19:14–17
- Brown MG, Keyser B, Rothenberg ES (1992) Endoscopic carpal tunnel release. *J Hand Surg [Am]* 17:1009–1011
- Chow JCY (1989) Endoscopic release of the carpal ligament: a new technique for carpal tunnel syndrome. *Arthroscopy* 5:19–24
- Chow JCY (1993) The Chow technique of endoscopic release of the carpal ligament for carpal tunnel syndrome: four years of clinical results. *Arthroscopy* 9:301–314
- Cobb TK, Carmichael SW, Cooney WP (1994) The ulnar neurovascular bundle at the wrist. A technical note on endoscopic carpal tunnel release. *J Hand Surg [Br]* 19:24–26
- Erdmann MWH (1994) Endoscopic carpal tunnel decompression. *J Hand Surg [Br]* 19:5–13
- Evans D (1994) Endoscopic carpal tunnel release – the hand doctor's dilemma. *J Hand Surg [Br]* 19:3–4
- Feinstein PA (1993) Endoscopic carpal tunnel release in a community-based series. *J Hand Surg [Am]* 18:451–454
- Garcia-Elias M, Sanchez-Freijo JM, Salo JM, Luch AL (1992) Dynamic changes of the transverse carpal arch during flexion-extension of the wrist: effects of sectioning the transverse carpal ligament. *J Hand Surg* 17A:1017–1019
- Gartsman G, Kovach J, Crouch C, Noble P, Bennett J (1986) Carpal arch alteration after carpal tunnel release. *J Hand Surg [Am]* 11:372–374
- Kelly CP, Pulisetti D, Jamieson AM (1994) Early experience with endoscopic carpal tunnel release. *J Hand Surg [Br]* 19:18–21
- Lanz U (1977) Anatomical variations of the medial nerve in the carpal tunnel. *J Hand Surg* 2:44–53
- Rowland EB, Kleinert JM (1994) Endoscopic carpal-tunnel release in cadavera. An investigation of the results of twelve surgeons with this training model. *J Bone Joint Surg [Am]* 76:266–268
- Schultz RJ, Endler PM, Huddleston HD (1973) Anomalous median nerve and anomalous muscle belly of the first lumbrical associated with carpal-tunnel syndrome. *J Bone Joint Surg [Am]* 55:1744–1746
- Seiler JG, Barnes K, Gelberman RH, Chalidong P (1992) Endoscopic carpal tunnel release: an anatomic study of the two-incision method in human cadavers. *J Hand Surg [Am]* 17:996–1002
- Sennwald G (1987) *The wrist*. Springer, Berlin Heidelberg New York
- Spinner M (1978) Injuries to the major branches of peripheral nerves of the forearm. Saunders, Philadelphia, pp 203–210
- Szabo RM, Pettey J (1994) Bilateral median nerve bifurcation with an accessory compartment within the carpal tunnel. *J Hand Surg [Br]* 1:22–23
- Viegas SF, Pollard A, Kaminski K (1992) Carpal arch alteration and related clinical status after endoscopic carpal tunnel release. *J Hand Surg [Am]* 17:1012–1016