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ORIGINAL STUDY

Outcome of open versus endoscopic approach for the surgical treatment of carpal tunnel syndrome

Michel P. J .VAN DEN BEKEROM, Eric BREEMANS, Karel SCHÄFFER

From the Gelre Hospitals, Apeldoorn, The Netherlands

The authors retrospectively evaluated two comparable groups of patients who underwent either open (103 patients) or endoscopic decompression (86 patients) of the carpal tunnel with the two portal technique. There were 95 patients available for follow-up in the open group and 79 in the endoscopic group. The average follow-up period was 38 months (range : 12 to 60). Each patient received a questionnaire in order to determine if there was any difference in severity of symptoms and functional status, patient satisfaction and time to return to activities of daily living. The questionnaire also focused on complications and on readiness to undergo the same operation again. There was no significant difference between the two techniques in any of the outcome measurements.

Keywords : carpal tunnel syndrome ; nerve compression ; open release : endoscopic release.

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common and probably the best known entrapment neuropathy. About 6% of women and 0.6% of men in a Dutch adult population have a CTS during lifetime (*9*). Diagnosis is usually straightforward, and based on clinical and electrophysiological findings. Surgical treatment of CTS was first described in 1947 by Brain *et al* (*2*). The open approach to divide the transverse carpal ligament has been the mainstay of surgical treatment ever since. Despite the success of this procedure, complications such as painful and deforming scars, tendon and nerve injuries, palmar haematoma, inflammation, complex regional pain syndrome (CRPS) and delayed return to work were frequently reported (*4, 11, 13, 19*). An endoscopic approach to the transverse carpal ligament was first reported in 1989 (*21*). This technique has the advantage of reducing scar size, minimising postoperative pain, enhancing recovery of grip strength and accelerating return to work.

While persistent controversy surrounds the use of endoscopic carpal tunnel release (ECTR), its favourable cosmetic and functional results have contributed to its growing popularity among both orthopaedic surgeons and patients, according to many authors. Nevertheless, early experience suggests that it is more complex than conventional open techniques.

The authors wanted to contribute to the ongoing debate by comparing the results of open carpal

■ Michel P. J. van den Bekerom, MD, Registrar in Orthopaedic Surgery.

■ Eric Breemans, MD, Orthopaedic Surgeon.

■ Karel Schäffer, MD, Orthopaedic Surgeon.

Correspondence : Karel Schäffer, Gelre Hospitals, site Lukas, Orthopaedic Department, Post bus 9014, 7300 DS Apeldoorn, The Netherlands.

E-mail : karelschaffer@yahoo.com.

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tunnel release (OCTR) with those obtained with the two-portal endoscopic carpal tunnel release (ECTR).

PATIENTS AND METHODS

Patient selection

This retrospective study included 189 patients with CTS, operated upon in the Gelre Hospitals, Apeldoorn, The Netherlands, between January 1, 2000 and December 31, 2003. The 103 open procedures were performed by three experienced surgeons, and the 86 endoscopic procedures by one surgeon familiar with endoscopic procedures. As a matter of fact, the 103 open procedures were part of a much larger group, operated upon in the same period, but reduced to one third of its original volume by selecting every third case record according to its chart number. There were 41 men and 148 women : 23 men (22%) and 80 women (78%) in the OCTR group, and 18 men (21%) and 68 women (79%) in the ECTR group. The mean age of the patients was 56.4 years (range : 20 to 92) in the OCTR group and 58.6 years (range : 31 to 88) in the ECTR group. This means that both groups were comparable.

The provisional diagnosis of CTS was made on the basis of pain, numbness, paraesthesiae, or weakness in the distribution of the median nerve at the wrist. The Tinel and Phalen provocative tests were used to assist in the diagnosis (*15*). An electrophysiological investigation was performed in all patients with CTS complaints. When this investigation showed a median nerve entrapment the patient was operated upon without trying conservative means. Therefore the selection criteria of all surgeons were the same. Patients who required additional procedures, besides the release of the median nerve, were excluded. Only the first operated hand of each patient was included in the study.

Surgical technique

The OCTR was performed under local anaesthesia without exsanguination. The incision (*3*) began 2 mm to the ulnar crease, just distal to Kaplan's oblique line (a line drawn from the apex of the interdigital fold between the thumb and index finger toward the ulnar side of the wrist, parallel with the proximal palmar crease, and passing 4 to 5 mm distal to the pisiform bone) and extended 3.5 to 4.5 cm proximally, to the distal crease of the wrist (*14, 24*). The superficial palmar fascia, transverse carpal ligament, and antebrachial fascia were divided. Neither tenosynovectomy nor neurolysis were performed. Usually four sutures were sufficient.

The two-portal ECTR was also performed under local anaesthesia, without tourniquet. A transbursal approach, through the ulnar bursa, was used, as described by Chow *et al* (*4-6*). The more recent extra-bursal modification of this technique makes the procedure much easier and improves visualisation of the proximal carpal ligament (*8, 22, 23*), but it was not used as yet. The entry portal was created by drawing a line, with a sterile pencil, from the proximal tip of the pisiform towards the radius, 15 to 20 mm in length, depending on the size of the hand. A second line, approximately 5 mm was drawn proximally from the end of the first line, followed by a small incision, 7 to 10 mm, from the end of the second line to the radius (fig 1). The exit portal was made in the palm surface on the bisector of the angle formed by the distal border of the fully abducted thumb and the third web space, and approximately 1 cm proximal to the junction of these lines (fig 2). Then the curved dissector-slotted cannula assembly unit was slipped under the carpal ligament. With the tip of this unit touching the hook of the hamate the hand was hyperextended and the cannula assembly was gently advanced distally, pointing towards the exit portal, until it became visible distally. The hand was now stabilised in a hand holder (fig 3). The trocar was removed and the scope was inserted proximally into the cannula so that the undersurface of the carpal ligament could be seen. A probe was always used to palpate the ligament and to ensure that no other tissue was present between the assembly and the carpal ligament. Any abnormal sensation in the patient's hand at this stage should alert the surgeon. If the surgeon had any doubt the tube was removed and reinserted. The transverse carpal ligament was then divided with a sequence of cuts by means of the probe and the triangular and retrograde knives supplied with the kit (fig 4). There was rarely any bleeding after endoscopic release, and only one suture per portal was necessary (fig 5). Conversion to an open procedure was never necessary.

Post-operative management

After surgery active exercises were started immediately in both groups. The patients were advised to avoid heavy lifting and direct pressure to the palm for 2 to 3 weeks, or until discomfort disappeared.

Fourteen days later all patients were examined by one of the surgeons. The sutures were removed and the patients were instructed to use the hand for activities of daily living and for their job, as tolerated. No other

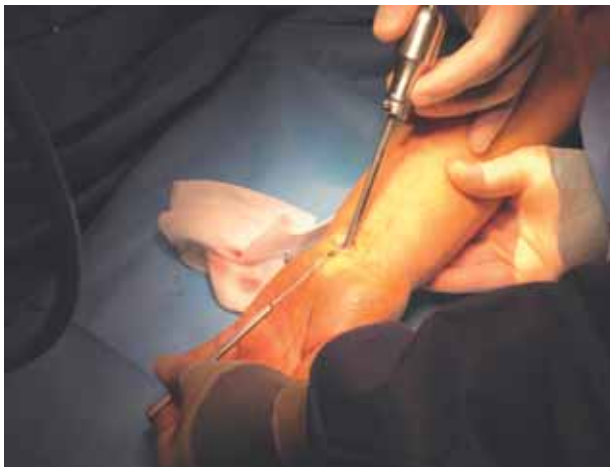

Fig. 1. — The entry portal for endoscopic carpal tunnel release.

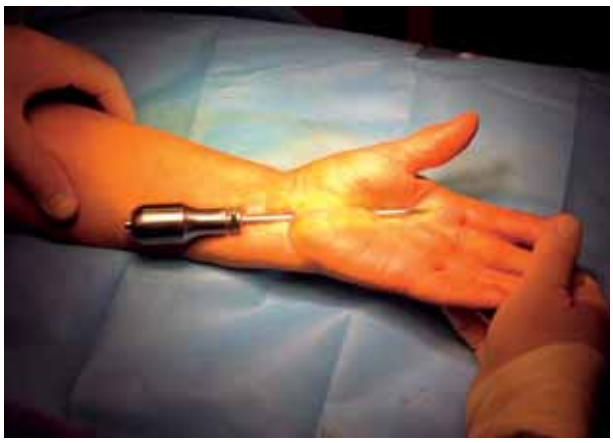

Fig. 2. — The palmar exit portal of the endoscopic carpal tunnel release (right).

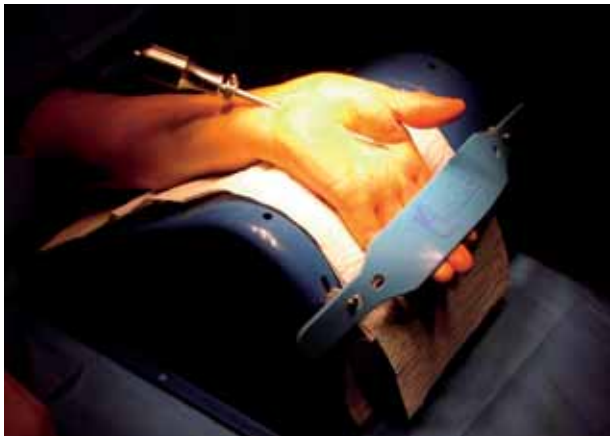

Fig. 3. — The hand is stabilised in the hand holder

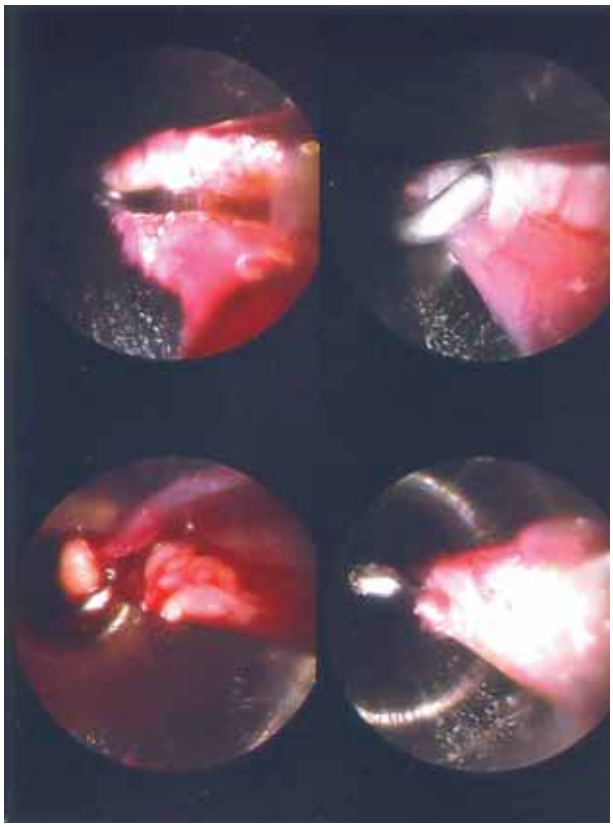

Fig. 4. — Releasing the carpal ligament endoscopically

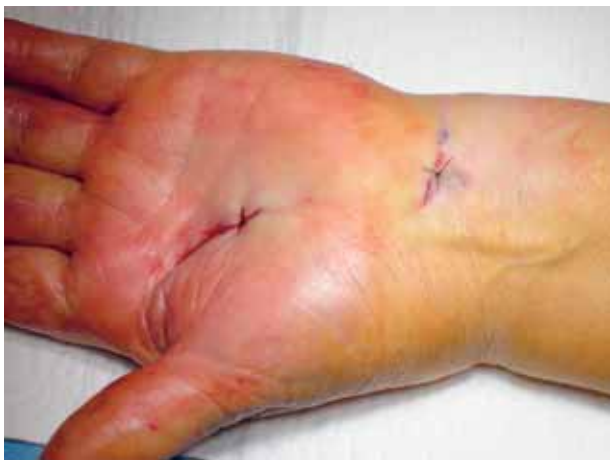

Fig. 5. — Only one suture is required per portal

guidelines were given. The patients were not seen again if they were free of complaints.

Evaluation

A questionnaire (*20*) was mailed to all the patients on January 1st, 2005. The average follow-up period was 38 months (range : 12 to 60). If necessary, the patients were contacted by telephone.

The first part of the questionnaire evaluated *the severity of postoperative symptoms and the functional status*, according to the scale described by Levine *et al* (*20*) (table I). This scale consists of 11 multiple choice questions. The scores range from 1 point (mildest) to 5 points (most severe). In other words, a score of 11 is the best possible condition. The overall score was calculated as the mean of the scores for the 11 individual items. Levine *et al* (*20*) reported that this scale was reproducible, internally consistent, valid, and responsive to clinical change ; moreover, that it measured dimensions of outcomes not captured by traditional measurements of impairment of the median nerve.

The patients were also asked to indicate their *level of satisfaction* with the outcome, on a scale from 0 to 10, 10 being the best possible result.

The r*eturn to preoperative activities of daily living* was stipulated in terms of weeks.

Table I. — Levine scale for severity of symptoms and functional status (Levine *et al*) (*20*)

How severe is the hand or wrist pain that you have at night ?
1. *I do not have hand or wrist pain at night*
2. *Mild pain*
3. *Moderate pain*
4. *Severe pain*
5. *Very severe pain*

How often did hand or wrist pain wake you up during a typical night in the past two weeks ?
1. *Never*
2. *Once*
3. *Two or three times*
4. *Four or five times*
5. *More than five times*

Do you have typical pain in your hand or wrist during the daytime ?
1. *I never have pain during the day*
2. *I have mild pain during the day*
3. *I have moderate pain during the day*
4. *I have severe pain during the day*
5. *I have very severe pain during the day*

How often do you have hand or wrist pain during the daytime ?
1. *Never*
2. *Once or twice a day*
3. *Three to five times a day*
4. *More than five times a day*
5. *The pain is constant*

How long, on average, does an episode of pain last during the daytime ?
1. *I never get pain during the day*
2. *Less than 10 minutes*
3. *10 to 60 minutes*
4. *Greater than 60 minutes*
5. *The pain is constant throughout the day*

Do you have numbness (loss of sensation) in your hand ?
1. *No*
2. *I have mild numbness*
3. *I have moderate numbness*
4. *I have severe numbness*
5. *I have very severe numbness*

Do you have weakness in your hand or wrist ?
1. *No weakness*
2. *Mild weakness*
3. *Moderate weakness*
4. *Severe weakness*
5. *Very severe weakness*

Do you have tingling sensations in your hand ?
1. *No tingling*
2. *Mild tingling*
3. *Moderate tingling*
4. *Severe tingling*
5. *Very severe tingling*

How severe is numbness or tingling at night ?
1. *I have no numbness or tingling at night*
2. *Mild*
3. *Moderate*
4. *Severe*
5. *Very severe*

How often did hand numbness or tingling wake you up during a typical night during the past two weeks ?
1. *Never*
2. *Once*
3. *Two or three times*
4. *Four or five times*
5. *More than five times*

Do you have difficulty with grasping and using small objects such as keys or pens ?
1. *No difficulty*
2. *Mild difficulty*
3. *Moderate difficulty*
4. *Severe difficulty*
5. *Very severe difficulty*

Table II. — Results obtained in both groups ; differences are not significant

	Open : OCTR (95 cases)	Endoscopic : ECTR (79 cases)
Postoperative severity of symptoms and functional status (Levine questionnaire)	13.7 ± 5	15.3 ± 6
Patient satisfaction	8.2 ± 2.4	8.3 ± 2.1
Time to return to activities	4.4 ± 3.8 days	4.5 ± 4.0 days
Complications	9/95 = 10%	10/79 = 13%
Readiness to undergo the same procedure again	90/95 = 95%	73/79 = 93%

Postoperative *complications* such as infection, slowed wound healing, scar tenderness and complex regional pain syndrome (CRPS) were asked for.

Finally the patients mentioned if they were *ready to undergo the same operation again*, if placed in the same circumstances.

Statistical analysis

An unpaired Student's t-test was used to compare the mean scores obtained in the two groups. A chi-square test was used to compare frequencies. The level of significance was set at 5% for two-tailed testing.

RESULTS

Ninety-five out of 103 OCTR patients were available for follow-up : 3 patients were lost for follow-up, 3 were excluded because they had undergone a re-operation, one patient had died, and one patient could not be evaluated because of severe rheumatoid arthritis.

Seventy-nine out of 86 ECTR patients were available for follow-up : 4 patients had died, one patient was lost to follow-up, one patient could not be evaluated because of severe rheumatoid arthritis, and one patient had undergone a re-operation.

An overview of the findings is presented in table II.

Severity of symptoms and functional state

In the OCTR group the average postoperative symptom severity score was 13.7 ± 5 (range : 11 to 29). The patient who scored 29 had a CRPS. In the ECTR group the average score was 15.3 ± 6 (range : 11 to 44), i.e. it was slightly worse. The patient who scored 44 in this group had a scar problem. The difference between both groups was not statistically significant. In the OCTR group 44 out of 95 patients (46%) had a perfect score of 11, and in the ECTR group 33 out of 79 patients (41%).

Patient satisfaction

The mean "patient satisfaction" score was 8.2 ± 2.4 in the OCTR group, and 8.3 ± 2.1 in the ECTR group, but the difference was not significant. Thirty-five out of 95 patients (37%) in the OCTR group, and 30 out of 79 patients (38%) in the ECTR group had a perfect "patient satisfaction" score of 10.

In both groups there were 2 patients who scored 1, i.e. extremely low, on the VAS for satisfaction. CRPS and scar tenderness were the causes, as well in the OCTR as in the ECTR group.

Return to preoperative activities of daily living

The average time to return to preoperative activities of daily living for the hands was 4.4 ± 3.8 weeks in the OCTR group, and 4.5 ± 4.0 weeks in the ECTR group. Again the difference was not significant. In the open group there were 33 out of 95 patients, or 35%, who returned to their preoperative activity level within 2 weeks, versus 26 out of 79, or 33%, in the endoscopic group.

Complications

In the OCTR group there were 9 out of 95 patients, or 10%, with a minor or major

complication (6 with scar tenderness, one with a wound infection, one with slowed wound healing, and one with CRPS). In the ECTR group 10 out of 79 patients, or 13%, had minor or major complications (5 with scar tenderness, 3 with slowed wound healing, and 2 with CRPS).

Readiness to undergo the same operation again

In the OCTR group 90 out of 95 patients, or 95%, were ready to undergo the same operation again. Three of the 5 dissatisfied patients had a postoperative complication. In the ECTR group 73 out of 79 patients, or 93%, would make the same choice again. Three of the 6 dissatisfied patients had a postoperative complication.

DISCUSSION

This study compares two technically different approaches to the same problem in a series of patients operated upon in a short period of time (3 years). However, it has several limitations. In the first place, the authors compare three "open" surgeons with one "endoscopic" surgeon. In the second place, the study is retrospective, while the literature offers several prospective randomised studies (*1, 3, 12, 17, 18, 28*).

OCTR is the most frequently performed technique for release of the median nerve. Previous studies have demonstrated that this operative treatment provides lasting alleviation of symptoms in more than 80% of patients (*8, 22, 23*). Thoma *et al* (*27*) concluded in their meta-analysis that ECTR is superior after 12 weeks, with respect to scar tenderness and recovery of strength. However, his study is inconclusive with regard to relief of symptoms and return to work.

ECTR was introduced as an alternative, to reduce the morbidity associated with OCTR. However, this has led to much controversy as to safety, success, and, most importantly, complication rate.

Studies of carpal tunnel release have generally focused on assessment of severity of symptoms and functional status, but have not used standardised measures with demonstrated reproducibility or validity. This is why the self-administered questionnaire of Levine *et al* (*20*) was used by the authors. The critical measurement properties of questionnaire scales include ease of administration, reproducibility, internal consistency, validity, and responsiveness to clinical change (*20, 29*).

What matters most for patients is the relief of pain, paraesthesiae and other neurological symptoms. In the current study the open and endoscopic approaches both led to a high degree of satisfaction, without a significant difference between the two groups. Asking the patients to evaluate their satisfaction with a VAS score is simple, but the analysis of this answer is more complex than it looks (*26*). Patients can have too high expectations of the operation, their answer can be influenced by mood changes, the surgeon or nurse was not friendly, etc.

In the current series which ranged from the very active manual labourer to the elderly sedentary person, there was no significant difference in the time needed to regain the pre-operative level of activities. Kerr *et al* (*18*) found that patients treated endoscopically returned to work 10.6 days sooner than those treated openly, and this was significant ($p = 0.01$). Also Brown *et al* (*3*) found that the open method resulted in a longer time interval before the patient could return to work (median 28 days, versus 14 days for the endoscopic-release groups). Bande *et al* (*1*) could not demonstrate any statistical difference in return to activity between the open and the one-portal endoscopic technique. Maybe there are other factors that are more determinant in returning to preoperative activity than surgical technique. Chow and Hantes (*7*) and Hallock and Lutz (*16*) concluded that patients without workers' compensation returned to work earlier than did workers' compensation patients. But Kerr *et al* (*18*) found that patients treated endoscopically, irrespective of insurance class, returned to work 10.6 days sooner than did those treated by the open procedure and this was statistically significant ($p = 0.01$). Saw *et al* (*25*) recommended that endoscopic carpal tunnel release should be considered in the employed as a cost effective procedure, but perhaps not in the general population as a whole.

Whichever technique is used, the avoidance of complications is of high importance for the surgeon. There is a legitimate fear that excessive enthusiasm for the endoscopic technique will lead to more complications, especially during the inevitable steep learning curve. On the other hand, careful compliance with the technique can reduce complications, and conversion to an open procedure is always possible (*1*). Complications have been described with both techniques. Einhorn and Leddy (*10*), for instance, showed in their survey that the endoscopic technique is not safer than the open technique. The authors had 10% versus 13% minor or major complications in the OCTR and ECTR groups, respectively.

Readiness to undergo the same operation again, in the same preoperative situation and with the same complaints, was another way to evaluate the patients' satisfaction. About 50% of the "no" patients had been confronted with a post-operative complication. The other 50% had a limited relief of symptoms after the operation.

CONCLUSION

The authors felt that most surgeons are not well trained in both techniques : closed as well as open release of the carpal tunnel. For this reason they compared three well trained "open" surgeons with a well trained "endoscopic" surgeon.

Nevertheless, the current study failed to demonstrate any significant difference between open and endoscopic carpal tunnel release. This confirmed the studies of Bande *et al* (*1*), Ferdinand and MacLean (*12*), Hallock and Lutz (*16*), and Jacobsen and Rahme (*17*).

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