ACTA MED OKAYAMA 1999; 53(4): 179-183

Evaluation of Release Surgery for Idiopathic Carpal Tunnel Syndrome: Endoscopic Versus Open Method

Kenya HASEGAWA, Hiroyuki HASHIZUME*, Masuo SENDA, Akira KAWAI and Hajime INOUE

Department of Orthopaedic Surgery, Okayama University Medical School, Okayama 700-8558, Japan

To evaluate the usefulness of endoscopic carpal tunnel release (ECTR) on patients with idiopathic carpal tunnel syndrome, multiple aspects of the results of 44 hands (42 patients) treated by ECTR and 40 hands (40 patients) treated by open carpal tunnel release (OCTR) were compared. Results of ECTR were compared with those of OCTR to study not only recovery rate and surgical safety but also cost-effectiveness. Although ECTR was much less invasive than OCTR, recovery of median nerve palsy in the ECTR group was not as good as that in the OCTR group one month after the surgery. Three months after surgery, the palsy of patients treated by ECTR had improved to almost the same extent as in those treated by OCTR. There were no major surgical complications in both ECTR and OCTR groups. The cost and time needed for ECTR treatment was 1/3 of those needed for OCTR. ECTR reduced both cost and treatment time, which is beneficial for both doctors and patients.

Key words: carpal tunnel syndrome, surgical treatment, endoscopic carpal tunnel release, open carpal tunnel release

Carpal tunnel syndrome (CTS) is an entrapment neuropathy (1) of the median nerve induced by increased pressure in the carpal canal (tunnel) due to various causes (2, 3). The aim of surgical treatment for CTS is to reduce the pressure in the carpal canal by dissecting the flexor retinaculum (FR), which makes up the palmar aspect of the carpal canal.

The first surgical treatment for CTS was performed by Learmonth (4) in 1930. In his technique, the FR was cut without direct observation with a pair of scissors inserted at the wrist crease. Today, to prevent complications such as injuries to the median nerve and flexor tendons, the FR is directly observed during surgery and is incised (open carpal tunnel release, OCTR) (5, 6). In 1986, Okutsu *et al.* (7) developed endoscopic carpal tunnel release (ECTR) for CTS using the Universal Subcutaneous Endoscope system. Since then, various endoscopic treatment methods have been developed (8-10).

ECTR is considered to be more advantageous than OCTR because it requires a shorter treatment period and is less invasive (7, 11). Only a few studies have been performed, however, comparing ECTR and OCTR in terms of the recovery rate for median nerve palsy, safety and cost effectiveness (12). In this study, these factors were analyzed in 82 patients (84 hands) who were followed up for more than 12 months.

Subjects and Methods

Subjects. Forty-four hands (42 female patients; mean age, 55.8 years) were treated by ECTR from 1993 to 1997 in the Okayama University Hospital. Forty hands (40 female patients; mean age, 52.3 years) were treated by OCTR from 1990 to 1993 in the same hospital.

Clinical and electrophysiological evaluation. Preoperatively, patients were classified according to the following criteria:

Grade I) mild symptoms (numbness, paresthesia, no atrophy of the thenar muscle and complete opposition).

Grade II) moderate symptoms (numbness, paresthesia and some atrophy of the thenar muscle but complete opposition).

Grade III) severe symptoms (numbness, paresthesia and significant atrophy of the thenar muscle with incomplete

* To whom correspondence should be addressed.

opposition).

Surgical treatment was indicated by the grade. Patients with Grades II or III CTS underwent surgical treatment. Patients with Grade I were also treated by surgery if their distal motor latency (DML) was 7.1 msec or more, or if the DML was between 5.2 msec and 7.0 msec and 3 months' conservative treatment had not been effective.

In the ECTR group, patients underwent surgery as outpatients according to Okutsu's method (13), under local anesthesia with buried sutures. The forearm to hand region was not immobilized after surgery. Patients were instructed to begin finger exercises the day after surgery and to keep the hand dry for 1 week. In the OCTR group, surgery was performed under brachial plexus block anesthesia while the patient was an inpatient (2–6 days after admission, mean 3.7) in the university hospital, without plaster immobilization and with a drip infusion of antibiotics. Patients left the hospital 1–6 days after surgery (mean, 4.4 days). The stitches were removed 10–14 days after surgery on an outpatient basis. Following this, the patients were treated as outpatients once every 10–14 days. The patients did not receive physiotherapy, but they were instructed to do exercises at home.

Clinical results were evaluated according to Kelly's criteria (14): Excellent, complete relief of symptoms; good, persistence of occasional minor symptoms; fair, some constant or annoying symptoms; poor, symptoms unchanged or worse. They were evaluated 1, 3, 6 and 12 months after surgery.

DML was also evaluated 1, 3, 6 and 12 months after surgery. The DML values were statistically analyzed by the t-test. Surgical complications in patients treated by ECTR and OCTR were compared.

Economic evaluation. Money and time spent by patients in each group were calculated as follows:

1) ECTR group: The money spent in this group was calculated based on the following figures: Re-consultation, ¥500/visit; other visits as an outpatient, ¥420/visit; ECTR, ¥29,500; postoperative care for a skin incision, ¥350/visit; prescription from an outside pharmacy, ¥760/each.

2) OCTR group: The basic costs for inpatients were hospitalization, ¥7,550/day; medical supervision during hospitalization, ¥5,450/day; brachial block anesthesia, ¥1,500; OCTR, ¥29,500 with an additional ¥80,000 for neurolysis; plaster fixation from the forearm to hand, ¥7,200; postoperative care for a skin incision, ¥350/treatment; treatment for resolution and pain-killing, ¥350/treatment; technical fee for drip infusion, ¥900/time; simple physiotherapy, ¥1,550/day. The basic costs for outpatients were: Re-consultation, ¥500/visit; other visits as an outpatient, ¥420/visit; postoperative care for a skin incision, ¥350/treatment; simple physiotherapy, ¥1,550/day; technical fee for intravenous injection, ¥240/visit; prescription from an outside pharmacy, ¥760/prescription.

For the OCTR group, the mean total expense was calculated as the amount spent during the period from hospitalization to resumption of work. For the ECTR group, the mean total expense was calculated as the amount spent from surgery to resumption of work because this group underwent surgery without hospitalization. The expenses for preoperative examination and drugs, which were almost the same for both groups, were excluded from the calculations.

Results

Clinical and electrophysiological results of ECTR and OCTR. The clinical results of ECTR and OCTR are shown on Table 1. At 1 month, the results of those patients who had undergone ECTR were inferior to those who had undergone OCTR, but recovered to almost the same level at 3 months after surgery.

In the ECTR group, there were no major surgical complications. Most patients (39 of 44 hands, 89 %) had no complaints at the 12 month evaluation. Five patients had minor complaints: Numbness around the region in 2 hands, swelling of the scar in 1 hand, and a feeling of disorder in flexing fingers in 1 hand. Other minor complaints were difficulty in exerting force in 2 hands and in doing fine work in 1 hand, but only 1 patient complained of inconvenience in daily life.

In the OCTR group, no complaints were recorded in 34 hands (85 %) at the 12 month evaluation. Complaints recorded in the early stages were numbness and pain around the region in 3 hands, swelling of the scar in 3 and pain when putting pressure against the hand in 1 hand. Other complaints were difficulty in exerting force in 4 hands and in doing fine work in 3 hands. Although the complaints of the OCTR group were similar to those of the ECTR group, daily life inconvenience in 3 hands and difficulties in 1 hand were more severe.

In the ECTR group, surgical scars were 1–1.5 cm long (mean length, 1.2 cm) transversely on the distal

Table 1 Clinical results of endoscopic carpal tunnel release (ECTR) and open carpal tunnel release (OCTR)

Time after surgery	Results	Number of hands (%)					
		Grade I		Grade II		Grade III	
		ECTR (n = 19)	OCTR (n = 16)	ECTR (n = 17)	OCTR (n = 15)	ECTR (n = 8)	OCTR (n = 9)
1 month	Excellent	6(32)	11(69)	1(6)	4(27)	0(0)	0(0)
	Good	7(36)	5(31)	3(18)	7(46)	1(13)	3(33)
	Fair	6(32)	0(0)	9(52)	3(20)	1(13)	4(45)
	Poor	0(0)	0(0)	4(24)	1(7)	6(74)	2(22)
3 months	Excellent	14(74)	11(69)	4(24)	5(33)	0(0)	0(0)
	Good	5(26)	5(31)	10(58)	7(47)	2(25)	4(45)
	Fair	0(0)	0(0)	2(12)	2(13)	5(62)	3(33)
	Poor	0(0)	0(0)	1(6)	1(7)	1(13)	2(22)
6 months	Excellent	18(95)	16(100)	8(47)	9(60)	2(25)	2(23)
	Good	1(5)	0(0)	9(53)	4(27)	5(62)	3(33)
	Fair	0(0)	0(0)	0(0)	2(13)	1(13)	3(33)
	Poor	0(0)	0(0)	0(0)	0(0)	0(0)	1(11)
12 months	Excellent	18(95)	16(100)	10(59)	10(66)	1(13)	2(22)
	Good	1(5)	0(0)	7(41)	4(27)	5(61)	4(45)
	Fair	0(0)	0(0)	0(0)	1(7)	1(13)	2(22)
	Poor	0(0)	0(0)	0(0)	0(0)	1(13)	1(11)

Table 2 Changes in distal motor latency over time in patients who underwent endoscopic carpal tunnel release (ECTR) and open carpal tunnel release (OCTR)

Time after surgery	Distal motor latency (msec)					
	Grade I		Grade II		Grade III	
	ECTR (n = 19)	OCTR (n = 16)	ECTR (n = 17)	OCTR (n = 15)	ECTR (n = 8)	OCTR (n = 9)
0 (before surgery)	6.7 ± 1.4	6.2 ± 1.6	7.3 ± 1.7	7.2 ± 1.2	8.2 ± 2.3	8.0 ± 2.1
1 month	4.8 ± 1.0	4.8 ± 1.3	5.8 ± 1.2	6.2 ± 1.3	6.2 ± 1.7	6.3 ± 1.6
3 months	4.1 ± 0.6	4.1 ± 0.9	5.4 ± 0.7	5.7 ± 0.9	4.8 ± 2.0	4.8 ± 1.8
6 months	4.0 ± 1.0	4.0 ± 1.2	4.4 ± 0.8	4.3 ± 0.4	5.2 ± 0.9	5.1 ± 0.9
12 months	4.0 ± 1.0	3.8 ± 0.5	4.3 ± 0.7	4.0 ± 1.0	5.2 ± 1.3	5.0 ± 1.0

All values are expressed as mean ± SD.
There were no statistically significant differences between values for ECTR and OCTR (t-test).

forearm. The length of surgical scars in the OCTR group was 4–8 cm (mean length, 4.7) longitudinally on the palm. There were no complaints relating to scars in either the ECTR or the OCTR group.

Pre- and postoperative DML in the OCTR and ECTR groups are listed in Table 2. There were no statistically significant differences in DML values between the ECTR and the OCTR groups.

Economic results. The mean total cost of the treatment was ¥31,255 (¥29,600 to ¥34,100) in the ECTR group. The mean cost in the OCTR group was ¥112,025 (¥44,900 to ¥195,350) for inpatients and ¥3,585 (¥2,030–¥6,820) for outpatients. The mean total cost of the treatment was ¥111,505 in the OCTR group (Table 3).

The mean time spent for treatment was 9.8 days in the

Table 3 Comparison of time and money expenditures in patients treated by endoscopic carpal tunnel release (ECTR) and open carpal tunnel release (OCTR)

	Mean money spent for treatment (Yen)		Mean time spent for treatment (Days)	
	ECTR 42 patients (44 hands)	OCTR 40 patients (40 hands)	ECTR 42 patients (44 hands)	OCTR 40 patients (40 hands)
Hospitalization period	0	112,025	0	9.1
Outpatient period	31,255	3,585	9.8	23.2
Total	31,255	115,610	9.8	32.3

ECTR group. The mean time in the OCTR group was 9.1 days for hospitalization and 23.2 days for outpatients, totaling 32.3 days.

There was no cost for hospitalization, and the mean period from surgery to resumption of work was shorter in the ECTR group. The mean financial expenditure and time from surgery to resumption of work in the ECTR group were about 1/3 those of the OCTR group.

Discussion

The carpal canal has a tubular structure consisting of carpal bones on the back and sides, and the FR on the palmar side. Nine flexor tendons, together with the median nerve, pass through this canal. CTS is an entrapment neuropathy (1) caused by compression of the median nerve under the FR by increased pressure in the carpal canal. This increased pressure is caused by changes in bone structure, deformity (osteoarthritis and fractures), increased amounts of material in the carpal canal (calcium and amyloid deposition), hypertrophy of the FR, and by physical stress to the hand joint (overuse or by holding it in an extremely flexed position for long periods) (15).

Learmonth (4) performed OCTR for the first time as a surgical treatment for CTS. OCTR is a method now widely used for treating CTS, however, various problems have been reported (7, 11). These problems include: Patients' anxiety about surgery involving incision of a wide area of skin, swelling and bleeding of the surgical site, disorder of finger function due to adhesion of the flexor tendons, limited use of fingers for more than 1 month after surgery, scarring of the wrist joint, pain and scar contracture, and prohibition of air tourniquets in patients who are undergoing long-term hemodialysis treatment. To solve these problems, Okutsu *et al.* developed ECTR in 1986 (7). The objective of ECTR is basically the same as that of OCTR, namely, the median nerve is decompressed by cutting the FR to release and expand the carpal canal.

In this study, we examined the usefulness of ECTR as compared with that of OCTR. The difference in recovery rates at 1 month post-surgery may be caused by adhesion of the nerve due to the impossibility of avulsing the FR by ECTR while by OCTR the nerve is macroscopically decompressed by cutting all tissues from the skin to the FR.

Brachial plexus block anesthesia, which is usually used for OCTR, may induce complications such as pneumothorax. ECTR requires only local anesthesia which is less likely to cause complications. No complaints were voiced from our patients in the ECTR group regarding scars, pain or numbness. Another advantage of ECTR is that it involves less invasion of the regions from the skin to the FR.

The cost of treatment covering the period from ECTR to work resumption was about 1/3 that of OCTR, which was shorter than that reported in the evaluation by Hiura *et al.* (12). This difference may be due to the fact that no hospitalization or hospital visits were required for stitch removal in the patients we studied. The period from hospital visit to the resumption of work in the ECTR was less than half of that in the OCTR group.

We usually perform ECTR for Grade II and III patients, however, it is sometimes difficult to decide whether or not to perform this method on patients classified as Grade III. It has become clear in this study that even though the results were variable in Grade III patients compared with Grade I and II patients, the results of Grade III patients were satisfactory 3–6 months after surgery. Since less invasive treatment is generally considered better, as long as results are similar, patients were informed before surgery of the relative merits of ECTR in comparison with OCTR. ECTR was performed if patients consented.

To perform ECTR, it is important to acquire a full knowledge of the anatomical structures involved and to have highly developed techniques. Okutsu claimed that ECTR should not be attempted if anomalous anatomical structures are suspected (16). Electrophysiological and clinical results of both ECTR and OCTR are equal. To assure that ECTR achieves complete decompression we monitor carpal tunnel pressure during surgery (17).

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Received January 5, 1999; accepted April 19, 1999.