Long term results after operative therapy of Carpal Tunnel Syndrome

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Summary. *Objective:* Aim of the study was to investigate long term outcome in patients after open and endoscopic surgery treatment of Carpal Tunnel Syndrome.

Methods: In this prospective randomised neurological long term follow up study, 120 patients were included at the beginning who underwent a Carpal Tunnel release procedure. 99 patients were followed up at 9 months and 88 patients at 4¼ years following surgery. 54 patients aged 53.3±11.8 years (41 female, 13 male) underwent conventional open procedure (right hand 33, left hand 21) including epineural neurolysis of the median nerve and 46 patients aged 51.9±11.1 years (30 female, 16 male) underwent an agreed endoscopic procedure. Clinical examination and Electroneurographical measurements were performed pre-operatively, nine months and 4¼ years after surgery.

Results: Over the period of the study both disturbance of sensation and grip strength improved. Pain at night and paraesthesias improved particularly well. At the second follow up there was an increase of disturbed sensitiveness. Distal motor latencies of the median nerve improved significantly in both groups in both hands at first follow up, but not at the second follow up.

Conclusions: Overall improvement of complaints and strength supports surgical treatment. Worsening of sensitiveness over time requires further prospective studies.

Keywords: entrapment syndromes, carpal tunnel syndrome (CTS), open surgery treatment of CTS, endoscopic surgery treatment of CTS.

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INTRODUCTION

Carpal Tunnel Syndrome is the most common entrapment neuropathy, and it is caused by compression of the median nerve at the wrist. Incidence rates increase with age for men, whereas for women the rates peak at 45–54 years of age. Prevalence among older people is almost four times greater for women than for men [10]. Many authors are convinced, that Surgery is the definitive treatment for carpal tunnel syndrome. In early follow up investigations, no substantive differences in benefit could be shown for different methods of Carpal Tunnel release [2, 9, 12, 15]. The cochrane reviewer concluded that there is no strong evidence supporting the need for replacement of standard open carpal tunnel release by existing alternative surgical procedures for the treatment of carpal tunnel syndrome [13]. In most of the prospective long term studies patients are followed up 6 to 12 months. Only in one study, patients were interviewed by the surgeons, at a mean follow-up of 4.5 years. In this study, 72% of hands were free of symptoms and 94% were described by the patients as functionally normal [4].

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PATIENTS AND METHODS

At the beginning of this prospective randomised neurological long term follow up study 120 patients were included who underwent a carpal tunnel release procedure. It was possible to follow up 99 patients at a mean of 9 months [12] and 88 patients at a mean of 4¼ years past surgery treatment. 54 patients aged 53.3±11.8 years (41 female, 13 male) underwent conventional open procedure (right hand 33, left hand 21) including epineural neurolysis of the median nerve and 46 patients aged 51.9±11.1 years (30 fe-

Table 1. **CTS open surgery: frequency of clinical symptoms and findings (%)**

Parameter	Pre-OP n=53	1.follow up n=53	2.follow up n=47
Pain (total)	73.6	28.3	14.9
- at night only	28.3	0	4.3
- at day and night	30.2	5.7	4.3
- early in the morning	22.6	9.4	6.4
- after strain of the hand	30.2	18.9	10.6
- at day only	7.5	17	10.6
Subjective weakness of the hand	56.6	34	31.9
Lets dropping things	45.3	15.1	17.0
Subjective disturbance of sensitiveness	47.2	17	57.4
Paresthesias	77.4	9.4	34.0
Hypoesthesia fingers only	41.5	24.5	66
Hypesthesia whole area of median nerve	49	9.4	66
Hypalgesia	37.7	22.6	19.1
Functional deficit of thumb opposition	56.6	24.5	80.9
Atrophia of *m.abductor pollicis brevis*	18.9	18.9	10.6

Table 2: **CTS endoscopic surgery (Agee): frequency of clinical symptoms and findings (%)**

Parameter	Pre-OP n=46	1. follow up n=46	2. follow up n=41
Pain (total)	87	37	24.4
- at night only	32.6	0	14.6
- at day and night	34.8	8.7	14.6
- early in the morning	21.7	4.3	7.3
- after strain of the hand	34.8	23.9	22
- at day only	13	15.2	12.2
Subjective weakness of the hand	65.2	45.7	24.4
Lets dropping things	52.2	21.7	12.2
Subjective disturbance of sensitiveness	37	26.1	80.5
Paresthesias	87	21.7	24.4
Hypesthesia fingers only	45.7	28.3	73.2
Hypesthesia whole area of median nerve	43.5	15.2	80.5
Hypalgesia	47.8	23.9	26.8
Functional deficit of thumb opposition	67.4	21.7	87.8
Atrophia of *m.abductor pollicis brevis*	26.1	15.2	7.3

male, 16 male) Agee endoscopic procedure. Drop out was mostly caused by patients who ceased to take part in the follow up examinations. The documentation included: patient's age, sex, profession, duration of treatment disablement, return to the activities of daily life (ADL) and pre- and postoperative neurological symptoms and postoperative complications. Electroneurographical measurements were performed preoperatively, nine months and 4¼ years after surgery by the same neurologist. The conduction study criteria for CTS diagnosis were similar to literature [7, 8], and included a.) elongated distal motor latency of the compound muscle action potential obtained from the *abductor pollicis brevis* by supra-maximal stimuli on the median nerve at the wrist crease, with normal conduction velocity on the median nerve at the elbow-wrist segment; b.) abnormal antidrome sensory conduction study of median nerve compared to ulnar nerve antidrome sensory conduction velocity (1). In a former study comparison of results of corresponding orthodromic and antidromic nerve conduction velocity measurements along the different segments of sensory median nerve fibres revealed no significant disadvantages for the antidromic method [14]. Distal motor latency and motor conduction velocity (NC) of *n. medianus* and *n. ulnaris* were measured at both sides, with a standard electromyography equipment (Dantec). Distal latency of median nerve supramaximal wrist stimulation to different electrode on thenar eminence was standardised to a distance of 6.5 cm. Needle electromyography (EMG) was performed in cases of distinct atrophy or in some cases if denervation signs were individually needed for a decision to operate. Needle EMG examination confined to thenar muscles in CTS does not seem to provide any further information when NC data had already established diagnosis of carpal tunnel syndrome, and it should

Table 3: **CTS open surgery electrophysiological data and grip strength: motor latencies, signal amplitudes and conduction velocities** (recording parameters: sensitivity 2 mV, sweep 3 ms/D, low frequency filter 3 dB cut off 2 Hz, high frequency filter 3 dB cut off 10 kHz; stimulation: single negative rectangle impulse, duration 0.2 ms), * = significant difference compared with pre surgery findings, Welch's t-test $p<0.05$ (r. = right, l. = left, DL = distal latency in ms, MCV = motor conduction velocity in m/sec, A = amplitude in mV, n = newton)

	Pre-OP n=53	1.follow up n=53	2.follow up n=47
DL median nerve r,	5.14±1.28	4.35±0.65*	4.37±0.60*
A median nerve r.	10.59±5.38	10.98±4.99	8.03±3.6
MCV median nerve r.	52.18±5.38	52.41±4.75	51.41±4.77
DL ulnar nerve r.	3.38±0.3	3.3±0.28	3.66±0.46
A ulnar nerve r.	6.36±2.14	6.66±2.19	6.69±2.47
MCV ulnar nerve r.	57.22±3.92	58.85±4.95	56.43±5.46
DL median nerve l.	5.12±1.24	4.49±1.12*	4.14±1.1*
A median nerve l.	8.02±3.94	7.94±3.59	7.29±2.86
MCV median nerve l.	54.42±4.41	54.9±4.79	53.55±5.06
DL ulnar nerve l.	3.42±0.27	3.29±0.32	3.52±0.45
A ulnar nerve l.	6.09±1.99	6.21±2.3	6.68±2.43
MCV ulnar nerve l.	58.25±3.67	60.43±3.9	56.06±5.37
Grip strength r. [n]	169.34±78.11	202.27±76.73*	200.51±69.68*
Grip strength l. [n]	172.19±94.86	197.27±78.3	203.84±69.09*

Table 4. **CTS endoscopic surgery electrophysiological data and grip strength: motor latencies, signal amplitudes and conduction velocities** (recording parameters: sensitivity 2 mV, sweep 3 ms/D, low frequency filter 3 dB cut off 2 Hz, high frequency filter 3 dB cut off 10 kHz; stimulation: single negative rectangle impulse, duration 0.2 ms), * = significant difference compared with pre surgery findings, Welch's t-test $p<0.05$ (r. = right, l. = left, DL = distal latency in ms, MCV = motor conduction velocity in m/sec, A = amplitude in mV, n = newton)

	Pre-OP n=46	1.follow up n=46	2.follow up n=41
DL median nerve r,	6.04±2.33	4.56±0.72*	4.43±0.78*
A median nerve r.	8.69±4.83	10.2±4.58	7.47±4.01
MCV median nerve r.	50.70±7.04	50.45±7.9	52.39±5.25
DL ulnar nerve r.	3.42±0.26	3.37±0.3	3.66±0.51
A ulnar nerve r.	6.82±2.07	6.8±2.34	6.73±2.0
MCV ulnar nerve r.	57.24±4.13	58.4±5.06	57.45±5.05
DL median nerve l.	5.66±2.11	4.6±0.95*	4.21±0.70*
A median nerve l.	6.97±4.59	7.77±4.51	7.02±4.04
MCV median nerve l.	51.67±6.10	52.48±4.94	53.13±5.04
DL ulnar nerve l.	3.48±0.3	3.39±0.25	3.44±0.39
A ulnar nerve l.	6.34±2.49	6.67±2.34	7.15±3.12
MCV ulnar nerve l.	57.88±4.14	58.63±4.1	57.26±5.08
Grip strength r. [n]	181,5±80.36	202.86±92.12	230.5±83.1*
Grip strength l. [n]	174.44±85.26	205.41±97.02	228.24±79.38*

therefore not be performed routinely [16]. Grip strength was measured by a dynamometer calibrated to newton (n).

Chi-square-test, variance analysis and Welch's t-test were used for statistics. Frequency differences were checked for significance by chi-square test. Significance was accepted at less than 5% ($p<0.05$).

RESULTS

At the first follow up of 99 patients after in mean 9 months there was found significant improvement of all complaints in clinical findings. Pain at night and paresthesias improved especially clearly (table 1 and 2). Only 9 patients (17%) in the open surgery group and 8 patients (17.4%) in the endoscopic surgery group had relevant persistent complaints and permanent prolonged distal latencies. At the second follow up of 88 patients after in mean 4¼ years complaints in general improved further except complaint of disturbance of sensitiveness. The clinical investigation showed an increase of frequency of disturbed sensitiveness in the area of the median nerve. These changes are significant considering dropouts. Figure 1 shows the course of two point discrimination at the finger tip of the index fin-

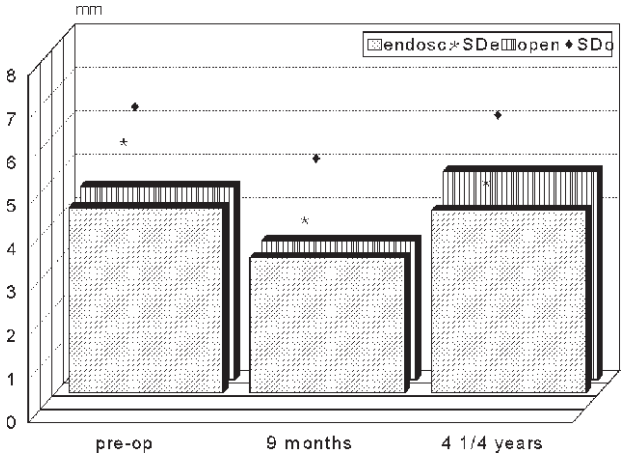

Figure 1. **Course of two-point discrimination at the fingertip of the index finger**

ger, which is improved up to the first follow up and worsened up to the second follow up. In contrast, grip strength (table 3 and 4) improved significantly in both groups until the second follow up. At the second follow up 4 patients (8.5%) in the open surgery group and 5 patients (12.2%) in the endoscopic surgery group had relevant persistent complaints and prolonged distal latencies. The difference was not significant (Chi square test). Distal motor latencies of median nerve (table 3 and 4) improved significantly in both groups and both hands until the first follow up, but not further until the second follow up. Signal amplitudes and motor conduction velocities of median nerves did not change significantly during the observation period. There was no significant difference between both surgery groups. The only difference between the open and endoscopic surgery groups was that working people returned earlier to work after endoscopic surgery.

DISCUSSION

Conservative treatments, such as wrist splinting and steroid injections, are also effective for the relief of carpal tunnel symptoms, but their use is discussed controversial because they only offer long-term relief in a minority of patients [6, 17]. In conclusion, there is still little known about the efficacy of most conservative treatment options for CTS. To establish stronger evidence more high quality trials are needed [5]. So many physicians prefer surgery treatment, because of a good short-term effect.

In our long term follow up of patients after surgery of carpal tunnel syndrome there was no significant difference of outcome in patients with open or endoscopic surgery. Especially the neurophysiological results were the same. We conclude from the results that epineural neurolysis of the median nerve was not necessary. The main argument pro endoscopic surgery was, that working people were earlier on work [12]. A meta-analysis on the results of eight studies compared the global outcomes of patients who received carpal tunnel release with the global outcomes of patients who received carpal tunnel release and neurolysis or epineurotomy. The meta-analysis suggests that patients who received such neural surgery tended to have poorer global outcomes than those who did not [3].

In a Brazilian study from 358 patients with clinical and conduction study diagnosis of CTS, 12 cases were identified that had refused surgical treatment, had not used anti-inflammatory medications, and had not undergone orthopaedic procedures, such as immobilization or anaesthetic infiltration. These 12 patients have 20 compromised hands, which have been followed up for between 4 and 9 years. In all cases sensory and motor conduction studies were performed on the median nerve, at the beginning and end of follow-up period. Electrical improvement was marked in 5 hands and slight in 3; there was no significant change in 10, and deterioration in 2. 8 hands (7 patients) showed improved clinical symptoms and conduction studies over several years. The authors conclude, that this brings the universally accepted procedure of surgical treatment into doubt [11]. In our follow up study after surgery treatment the improvement of distal latencies was more distinct and only very few patients had remaining prolonged distal latencies. So in this point of few our study supports surgery treatment.

In contrast to all improving parameters sensitiveness seems to worsen over time after surgery treatment of carpal tunnel syndrome, shrinking of the scar may cause this. We conclude that further long-term follow up studies are necessary to clarify this question.

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ILGALAIKIO STEBĖJIMO REZULTATAI PO OPERACINIO RIEŠO KANALO SINDROMO GYDYMO

Santrauka

Tikslas: Tyrimo tikslas buvo įvertinti ilgalaikio stebėjimo rezultatus po riešo kanalo sindromo atviro ir endoskopinio operacinio gydymo.

Metodika: Šiame prospektyviniame atsitiktinės atrankos neurologiniame ilgalaikio stebėjimo tyrime dalyvavo 120 ligonių, kuriems buvo atlikta riešo kanalo dekompresijos procedūra. Po chirurginio gydymo 99 pacientai sekti 9 mėnesius ir 88 pacientai – 4 metus ir 3 mėnesius. Įprasta atvira chirurginė procedūra (33 – dešinės, 21 – kairės rankos) su *n. medianus* epineuraline neurolize buvo atlikta 54 pacientams (41 moteris, 13 vyrų), kurių amžius 53,3±11,8 metai. Endoskopinė chirurginė procedūra buvo atlikta 46 pacientams (30 moterų, 16 vyrų), kurių amžius 51,9±11,1 metai. Prieš operaciją ir po jos praėjus 9 mėn. bei 4 metams ir 3 mėn. buvo atliekamas klinikinis neurologinis ir elektroneuromiografinis tyrimas.

Rezultatai: Ilgalaikio stebėjimo metu nenustatyta reikšmingų skirtumų tarp pacientų, operuotų atviru ar endoskopiniu būdu. Elektroneuromiografinio tyrimo rezultatai abiem atvejais buvo vienodi. Tyrimo laikotarpiu pagerėjo ir jutimo (ypač skundai dėl naktinių skausmų ir parestezijų), ir plaštakos jėgos sutrikimai. Antrojo apsilankymo metu nustatytas didesnis jutimų sutrikimų skaičius. Pirmojo stebėjimo vizito metu abiejose grupėse nustatyta žymiai pagerėjusi abiejų rankų *n. medianus* distalinė motorinė latencija, tačiau to nenustatyta antrojo vizito metu.

Išvados: Reikšmingų ilgalaikio stebėjimo skirtumų po riešo kanalo sindromo atviro ar endoskopinio operacinio gydymo nenustatyta. Jutimo ir jėgos sutrikimų pagerėjimas patvirtina operacinio gydymo pasirinkimo tinkamumą. Vėlesnis jutimų pablogėjimas reikalauja tolesnių prospektyvinių tyrimų.

Raktažodžiai: tunelinis sindromas, riešo kanalo sindromas (RKS), atviras chirurginis RKS gydymas, endoskopinis RKS gydymas.