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Original Article

Complementary treatment options in carpal tunnel syndrome surgery; Prospective randomized controlled study

Yakup Ekinci[1], Ersin Kasim Ulusoy[2], Alper Cirakli[3]

[1]Kayseri Training and Research Hospital, Orthopedics and Traumatology Clinic, Kayseri, Turkey
[2]Kayseri Training and Research Hospital, Neurology Clinic, Kayseri, Turkey
[3]Ordu University Faculty of Medicine, Department of Orthopedics and Traumatology, Ordu, Turkey

Abstract

Aim: In this study, we aimed to determine the efficacy of splinting and exercise modalities in addition to surgical treatment in advanced carpal tunnel syndrome (CTS) cases.

Material and Method: Patients were divided into 3 different groups according to the order of application, and after surgical intervention their treatment was continued according to the group they were in. There were 51 hands in 50 female patients in group 1 (control group); 52 hands in 51 female patients in group 2 (exercise group); 52 hands in 50 patients in group 3 (wrist splint group). Patients were given a follow-up number by computer software under which the following data were recorded: age, body mass index (BMI), date of surgery, operated side, preoperative disorders, pre and postoperative EMG findings, surgical technique, pre and postoperative visual analogue scales (VAS), pre and post-operative Boston Carpal Tunnel Questionnaire (BCTQ) and post-operative complications. Kolmogorov-Smirnov test and Spearman's rho correlation coefficient (r) were used for statistical analysis.

Results: There was no statistical difference between the groups in terms of VAS and FSS change. However, there was a statistically significant difference in terms of BSSS change. In the exercise group (Group 2) it was found that the healing was better and faster than the other groups.

Conclusion: We believe that early and effective postoperative exercise, which is to be applied in addition to surgical treatment in advanced CTS cases, leads to healing of the patient and, in parallel, early return to work.

Keywords: Carpal Tunnel Syndrome; Entrapment Neuropathy; Surgery; Exercise; Splinting.

INTRODUCTION

Carpal tunnel syndrome (CTS) was first described by Sir James Paget in 1854 (1). CTS, a result of compression of the median nerve in the carpal tunnel of a wrist is the most common nerve entrapment syndrome in the upper extremities, affecting 1-4% of the population (2). The majority of cases are idiopathic (3). The typical symptoms are pain especially at night, paresthesia in the distribution of the median nerve and wasting of the thenar muscles in advanced cases (4).

Many literature sources have shown the useful options in the treatment of CTS (5). Conservative treatment modalities such as splinting, nerve and tendon movement exercises and corticosteroid injection in early and mildly affected patients are the first choice of treatment (6-8). In cases where there is no response to conservative treatment, it is an effective and frequent method of removing Carpal tunnel release (CTR) symptoms. (2). CTR is accepted as the most reliable option, and the transverse carpal ligament (TCL) can be incised by various techniques, such as conventional, mini-open, and endoscopic. Open CTR is the generally accepted method and has reported a high success rate with minimal complications and is predictable for the postoperative outcomes (9).

In this study, we aimed to determine the efficacy of splinting and exercise modalities applied in addition to surgical treatment in advanced CTS cases.

MATERIAL and METHODS

This study was Institutional Review Board approved. Patients who underwent surgery with a diagnosis of CTS

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Corresponding Author: Ersin Kasim Ulusoy, Kayseri Training and Research Hospital, Orthopedics and Traumatology Clinic, Kayseri, Turkey, E-mail: ersinkasim_uluspy@hotmail.com

between 2014 and 2016 at the clinic of orthopedics and traumatology of city hospital, regularly attended follow-up and gave informed consent were included in the study.

The inclusion criteria were as follows: 1. patients met the clinical criteria suggested by Graham et al. (10), 2. positive findings in the electromyography (EMG), 3. CTS awakening from sleep at night, 4. mini-open CTR surgeries were performed by one surgeon and 5. postoperative follow-up period of at least 3 mounths. All patients enrolled were diagnosed with CTS only at the institution of the authors without a history of a diagnosis of CTS.

We excluded patients with the following characteristics: 1. clinical and/or electrodiagnostic findings with additional ulnar or radial nerve compression in the ipsilateral upper extremity, 2. combined cervical radiculopathy or myelopathy in the ipsilateral upper extremity electrophysiological findings of ulnar nerve compression around the wrist and elbow, 3. revision surgery for recurred patients, 4. a history of trauma to the tendons, ligaments, bones, or neurovascular structures below the elbow on the same side, and 5. a history of any surgery in this anatomical area and any congenital or acquired deformity of the elbow, wrist, or hand.

Patients that qualify to participate in the study were distributed into 3 different groups according to the order of application, and after surgical intervention their treatment was continued according to the group they were in. Postoperative patients were grouped as follows:

- Group 1 (control group): Patients that were not given any recommendations other than wound care.
- Group 2 (exercise group): Patients that were given a tendon and nerve gliding exercise program which provides active motion to the nerve and flexor tendons in the next day.
- Group 3 (wrist splint group): Patients who were operated after surgery and kept in splint for 2 weeks.

Patients were given a follow-up number by computer software under which the following data were recorded: name, surname, age, file number, body mass index (BMI), date of surgery, operated side, education, preoperative disorders, pre and postoperative EMG findings, surgical technique, intra-operative findings, pre and postoperative visuel analog scalas (VAS), pre and post-operative Boston Carpal Tunnel Questionnaire (BCTQ) and post-operative complications.

Electrophysiological Analysis

Nihon Kohden make (Nihon Kohden Corp., Tokyo, Japan) 4 channel electroneuromyography device was used for electrophysiological examination. Electrophysiological examination was based on anatomic localizations used by Oh (13). Sensorial nerve axon potential peak amplitude, transmission speed of sensorial nerve fibrils, motor nerve axon potential peak amplitude, distal motor latency and speed of motor nerve fibrils were measured. The diagnosis was made according to American Association of Electrodiagnostic Medicine (AAEM) criteria (11,12). The CTS level was grouped in three as mild, moderate and severe.

Questionnaire

This questionnaire form developed by Levine et al. in 1993 is completed by the patient (13). It consists of two sections as the Boston Symptom Severity Scale (BSSS) and the Functional Status Scale (FSS) items. BSS includes 11 and FSS 8 sections. Every section contains five separate responses; each response is graded from 1 to 5 points.

The mean score is calculated separately for BSSS and FSS and it is obtained by dividing the total score with the number of questions. The validity and reliability of the questionnaire has been confirmed (14). Its use in the evaluation of treatment effectiveness has been advised (15).

Surgical Technique

All surgeries were performed as outpatient procedures under local anesthesia using a non-sterile pneumatic tourniquet on the upper arm. Local anaesthesia was achieved with 6 cc. local anaesthetic (Prilocaine HCl, 20 mg/mL) infiltration. A longitudinal incision no greater than 1.5 cm. in length was performed in line with the fourth ray, extending to but not crossing the distal wrist crease, and the TCL was divided (Figure 1).

Figure 1. Decomprasion of nervusmedianus

After releasing the TCL, the distal end of the forearm fascia was also released, utilizing a push-cut technique. No ancillary procedures as tenosynovectomy were performed. Once certain that the carpal tunnel was fully released, the tourniquet was deflated, hemostasis was achieved, and the skin incision was closed with monofilament non-absorbable sutures The median duration of surgery was 15 minutes. Daily wound dressings were performed and sutures were removed on the postoperative 14th days.

Statistical Analysis

To determine if data were normally distributed, data were analyzed using the Kolmogorov–Smirnoff test. For percentage grip strength change and BCTQ evaluation,

nonparametric univariate analysis was performed with the Mann–Whitney U-test for comparison of three groups. Spearman's rho correlation coefficient (r) was used for assessing associations between continuous variables. All statistical analyses were performed using IBM SPSS Statistics, Version 15 (SPSS Inc., Chicago, IL, USA). All reported p-values were two-tailed with an alpha of 0.05, indicating statistical significance.

RESULTS

One hundred fifty three cases met the study criteria and were included for analysis. All patients demonstrated a positive Phalen's test, Tinel's sign, positive findings in the EMG and sensory changes in the distribution area of the median nerve awakening from sleep at night. There were 51 hands in 50 patients in group 1 (control group); 52 hands in 51 patients in group 2 (exercise group); 52 hands in 50 patients in group 3 (wrist splint group) (Table 1,2).

There was no statistical difference between the groups in terms of patients age and BMI (age p = 0.028, BMI p = 0.463) (Table 1).

Most of the participants in the all groups were female sex, and the right hand was more affected tby the CTS. Also, most of the patients were housewives. When the educational status of these patients were evaluated, it was seen that the number of university graduated patients was very low in all three groups (Table 1).

There was no statistical difference between the groups in terms of VAS and FSS change (VAS p = 0.164, FSS p = 0.785) (Table 3,4).

However, there was a statistically significant difference in terms of BSSS change (p = 0.031) (Table 5). The change in the control group was less than that of the exercise group. In Group 2, it was found that the healing was better and faster than the other groups.

Table 1. Demographic charateristics of the patients

		Total (n=155)	Control (n=51)	Exercise (n=52)	Splint (n=52)	p
Age		52.8±14.6	49.0±13.6	56.7±13.6	52.6±15.8	0.028
BMI		28.2±2.9	28.6±3.3	28.1±2.5	28.0±3.0	0.463
Side	Right	97 (62.6%)	30 (58.8%)	30 (57.7%)	37 (71.2%)	0.291
	Left	58 (37.4%)	21 (41.2%)	22 (42.3%)	15 (28.8%)	
Gender	Male	28 (18.1%)	8 (15.7%)	12 (23.1%)	8 (15.4%)	0.514
	Female	127 (81.9%)	43 (84.3%)	40 (76.9%)	44 (84.6%)	
Occupation	Housewife	120 (77.4%)	42 (82.4%)	39 (75%)	39 (75%)	0.589
	Other	35 (22,6%)	9 (17.6%)	13 (25%)	13 (25%)	
Location	City-Province	98 (63.2%)	40 (78.4%)	34 (65.4%)	24 (46.2%)	0.003
	Village	57 (36.8%)	11 (21.6%)	18 (34,6%)	28 (53.8%)	
Training	Illiterate	40 (25.8%)	9 (17.6%)	15 (28.8%)	16 (30,8%)	
	Primary and High school	109 (70.3%)	38 (74.5%)	37 (71.2%)	34 (65.4%)	0.089
	University	6 (3.9%)	4 (7.8%)	-	2 (3.8%)	

Table 2. Level comparisons

	Preop				3rd month			p (in-group)
	Light	Middle	Heavy	Very heavy	None	Light	Middle	
Control (n=51)	3 (5.9%)	36 (70.6%)	9 (17.6%)	3 (5.9%)	33 (64.7%)	14 (27.5%)	4 (7.8%)	<0.001
Exercise (n=52)	4 (7.7%)	37 (71.2%)	10 (19.2%)	1 (1.9%)	36 (69.2%)	8 (15.4%)	8 (15.4%)	<0.001
Splint (n=52)	6 (11.5%)	41 (78.8%)	4 (7.7%)	1 (1.9%)	38 (73.1%)	10 (19.2%)	4 (7.7%)	<0.001
p (across groups)			0.436			0.393		

Table 3. VAS comparisons.VAS: Visuel Analog Scale

	Preop	3rd month	p (in-group)
Control (n=51)	7.6±0.9	1.3±1.1	<0.001
Exercise (n=52)	7.9±0.7	1.3±1.3	<0.001
Splint (n=52)	7.7±0.8	1.0±0.9	<0.001
p (across groups)	0.108	0.403	

VAS: Visuel Analog Scale.

Table 4. BSSS comparisons

	Preop	3rd month	p (in-group)
Control (n=51)	43.2±4.9	13.6±2.9	<0.001
Exercise (n=52)	45.6±4.5	13.5±4.4	<0.001
Splint (n=52)	44.9±5.5	13.0±2.4	<0.001
p (across groups)	0.041	0.619	

BSSS: Boston Symptom Severity Scale

Table 5. FSS comparisons

	Preop	3rd month	p (in-group)
Control (n=51)	27.3±4.7	10.8±2.9	<0.001
Exercise (n=52)	27.9±3.5	10.8±4.5	<0.001
Splint (n=52)	27.2±3.8	10.5±2.8	<0.001
p (across groups)	0.564	0.908	

FSS: Functional Status Scale.

DISCUSSION

In this study, for the patients who were operated due to carpal tunnel syndrome, we have compared the patients which splinting have been applied and exercise was recommended with the patients which exercise or splinting application was not performed in the post-operative period in terms of healing. Using electro-physiological and Boston questionnaire form, we found that the improvement in the group that exercise was recommended had better and faster healing rate than other groups. This difference was statistically meaningful.

Carpal tunnel syndrome is the most common entrapment neuropathy of the upper limb. In clinical terms, the complaints of numbness and tingling in the fingers is accompanied by symptoms of pain and weakness due to the compression of the median nerve in the ligaments at the wrist level (2).

Conservative and surgical methods are applied in CTS treatment. Conservative methods are used in patients with mild to moderate symptoms who do not consider surgical options, and CTS surgery is often used in patients with severe electro-physiologic or severe symptoms who do not respond to conservative treatments (16). Long-term success rates after CTS surgery range from 75% to 90%. This healing rate depends on the patient's chronic illnesses (diabetes, hypothyroidism, etc.) and the postoperative rehabilitation process.

The expected benefits after CTS surgery includes the pain relief, elimination of movement restraint, and return to work early. Various studies have shown that the rehabilitation methods applied in the post-operative period increase the level and rate of the recovery (2,16). Keilani et al (17). have found that recovery is better in patients that were directed to early stage rehabilitation.

In our findings which support this study, in the group which we have recommended exercise in the post-operative period, the healing was better both clinically and electro-physiologically than the patient groups which were monitored with splinting applied and the patient groups which no splinting or exercise took place.

CTS affects women 10 times more than men and peaks at ages 40-60 on average. It is thought that the reason for this is that the carpal tunnel is narrower in females than males. It is also more common people live in rural areas, and in farmers as well as mounting, manufacturing, tailoring, cleaning workers who use their hands often (18). 81.92% of the patients in our study consisted of women, all of whom were rural and agriculture workers. For this reason, the expectation of the patients who went under surgery is that they should recover as soon as possible in order to prevent further loss of work power. It is important to complete the surgical treatment with exercise as we found at the end of our study. In the studies of Deskur et al. (18), 112 patients who underwent CTS operation; and the patients were divided into two groups to assess the effect of selective physical exercises on healing. While exercise is recommended for the first group from the day after the operation, it wasn't recommended to the other group. Compared with the findings at baseline and 6 weeks after the treatment, we observed that there was a further decrease in the number of symptoms causing hand dysfunction in the group performing postoperative exercise, compared to the patients who do not exercise. This difference is evident in the night pain, but also in sensory dysfunction and other symptoms. In our study, we found that the functional capacity of the exercise group was better at the end of the third month than the splint and control group using the Boston questionnaire.

In a prospective study including 30 CTS patients by Shalimar et al. (19), they have monitored the patients which splint is applied and not applied for six months. As a result, there was no statistically significant difference between the groups. In another study, Bhatia et al. have performed 45 post operation splint applications and compared it to 57 hands which splint application has not been performed. There was no statistically significant difference between the groups in terms of pain score. In our study, there was no statistically difference between the splint applied group and the control group in terms of third month pain score, FSS and BSSS (20).

The limitations of our study: 1) it was conducted in small groups, 2) the follow-up period was as short as three months, 3) the similarity between groups in terms of factors causing peripheral neuropathy such as diabetes, thyroid dysfunction, etc. has not been considered prior to the study.

CONCLUSION

As a result, in this study, for the patients who were operated due to CTS, we have compared the patients which splinting have been applied and exercise was recommended with the patients which exercise or splinting application was not performed in the post-operative period in terms of healing.

Using electro-physiological and clinical techniques, we found that the improvement in the group that exercise was recommended had better and faster healing rate than other groups. In CTS patients, the importance of exercise in the post-operative period should be explained. Thus, loss of work power, extra cost and poor quality of life due to late recovery can be further reduced by early exercise.

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