



Conservative or surgical treatment of carpal tunnel syndrome based on the severity and patient risk factors

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Abstract

Background The carpal tunnel syndrome (CTS) is the most common median nerve compression disease which may result in impaired nerve function. This study was carried out to determine which treatment is more appropriate for moderate or severe CTS patients with or without risk factors.

Materials and methods In a cohort prospective study, the patients with moderate CTS received a conservative treatment including night splint for 3 months, one methyl prednisolone injection whereas patients with severe CTS underwent surgical release. They were followed for 1 year using the bland scale based on the electromyography and nerve conduction velocity studies and five-point global assessment outcome scale.

Results Totally, 68 moderate CTS cases (32 patients with risk factors and 36 without any risk factors) and 32 cases with severe CTS (16 patients with risk factors and 16 without any risk factors) were assess at 6 months and 1 year following the treatment. Although about 22% of moderate CTS patients with risk factors changed to mild CTS after 6 months of conservative treatment, about 75% showed mild CTS or complete remedy following 1 year (P value < 0.001). This result was about 30% at 6 months and about 95% at 1 year following conservative treatment in patients with moderate CTS without risk factors. None of moderate CTS patients with or without risk factors underwent surgery after 1 year of follow-up. Although almost all patients with severe CTS, with and without risk factors, showed complete recovery or changed to mild CTS at 1 year postoperatively, the result was statistically significant for cases without risk factors (P value = 0.002).

Conclusion Conservative treatment for moderate CTS would be a good option, and the final result may be seen 1 year later; however, its positive effect is quicker and better for moderate CTS cases without risk factors. Surgical release of the carpal tunnel may be the best choice not only for severe CTS cases with risk factors but also for cases without risk factors. For obtaining consistent rapid result, it is recommended to do surgical release for all cases of moderate or severe CTS without considering risk factors, but more clinical researches are needed.

Level of evidence II.

Keywords Carpal tunnel syndrome · Treatment · Wrist · Risk factors

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Introduction

The carpal tunnel syndrome (CTS), the most common median nerve compression disease in the wrist region, can lead to impaired nerve function with sensory and motor deficits in fingers, if left untreated [1]. It is seen more in female than male with annual incidence of about 136/100,000 person/year [2]. The median nerve along with ten tendons pass through the carpal tunnel formed by the carpal bones dorsally and the transverse ligament (flexor retinaculum) in the anterior of the wrist. Hence, the median nerve is highly prone to being compressed in this closed tunnel [3]. Repetitive flexion and extension or vibration movements of the

wrist for a long time seen in some workers may increase the pressure inside carpal tunnel with the final result of CTS [4–8]. Moreover, any factor that increases the content or reduces the capacity of the carpal tunnel can trigger symptoms of CTS [1, 9, 10]. Systemic diseases and comorbidities such as rheumatoid arthritis, hypothyroidism, amyloidosis, diabetes mellitus, pregnancy, obesity, and local factors such as infection, inflammation, fractures, and dislocation are among the causes of CTS [11–13].

Nonoperative treatment choices such as wrist splints, rehabilitation, manual therapy, exercises, therapeutic ultrasound, and corticosteroid injection can be usually recommended for mild to moderate cases [14–18]. Surgical release of the carpal tunnel is an option for patients with severe CTS or moderate cases without response to nonoperative therapies [19–21]. The aim of this prospective research was to determine in which cases surgical treatment and in which cases conservative treatment is the most effective treatment by considering comorbidities and predisposing risk factors. So, we can select the best choice of treatment in CTS patients with risk factors and finally reduce the medical service costs.

Materials and methods

After approval of this prospective study by the ethics committee of the university in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards, the patients referred to the orthopedic outpatient clinic with signs and symptoms of CTS in 2016 were enrolled. Informed consent was obtained from all individual participants included in the study. After examination, electromyography and nerve conduction velocity (EMG–NCV) studies were requested to confirm the diagnosis. Severity of CTS was defined as mild, moderate, and severe based on the bland scale of EMG–NCV [22]. We did not ask for ultrasound imaging, computed tomography or magnetic resonance imaging according to our department protocol. The inclusion criteria were patients over 18 years of age with moderate or severe CTS, no any treatment received for CTS in the past 12 months, and cases filled and signed the consent form. Exclusion criteria were mild CTS, pregnancy or being in the period of 12 months after labor, patients received treatment in the past 12 months for CTS, history of wrist or distal radius fractures, patients suffering malignancies or mental illnesses, and any symptomatic sensory or motor deficit such as mononeuropathy of the upper limb, radiculopathy, cervical rib, stroke, and multiple sclerosis. The selected cases were divided into the groups of with or without risk factors defined as smoking, alcohol, wrist working jobs, high body mass index (BMI), history of steroid intake, menopause,

diabetes mellitus, hypothyroidism, wrist infectious diseases, inflammatory joint disease, and amyloidosis [11, 23–25]. According to having minimum a risk factor, we categorized four different groups; moderate CTS with risk factors, moderate CTS without risk factors, severe CTS with risk factors, and severe CTS without risk factors.

All patients with moderate CTS (with and without risk factors) were prescribed conservative therapy including night splint for 3 months at 0–5 degree of extension and 1 time steroid injection of 20 mg (0.5 ml) of methyl prednisolone at level of retinaculum toward the ulnar border of the ring finger as the first treatment option. After 1 year, if no improvement, surgery was recommended. The patients with severe CTS with and without risk factors underwent open carpal tunnel release.

Response to treatment was evaluated at 6 months and 1 year following the treatment using the bland scale based on the EMG–NCV studies and the five-point global assessment outcome (GAO) scale. 1 = worse; 2 = unchanged; 3 = slightly better; 4 = much better; 5 = completely treated. A score 3 or above was considered as treatment success [26].

Statistical analysis

Analysis was done using SPSS, version 21.0 for windows (SPSS Inc. Chicago, IL, USA). Descriptive variables were reported in frequency and percentage. The outcome of surgical treatment of severe CTS with risk factors was compared with those without risk factors. Moreover, moderate CTS cases with risk factors treated conservatively were compared to moderate cases without risk factors. The results were analyzed through Pearson's correlation coefficient, Wilcoxon test, Chi-square, and *T* test. *P* value less than 0.05 was considered as significant.

Results

Totally 100 cases (26 males, 74 females, mean age: 49.13 ± 13.45 , range: 22–95 years) had moderate or severe CTS followed for a year. Among 68 moderate cases (male: 16, female: 52, mean age: 55), 32 patients had risk factors, and 36 patients did not have any risk factors. Among 32 cases with severe CTS (male: 10, female: 22, mean age: 49), 16 patients had risk factors, and 16 patients did not have any risk factors.

Changes of bland scale and 5-point GAO scale in moderate conservatively treated CTS and severe surgically treated CTS cases without considering risk factors during the follow-up was shown in Tables 1 and 2. Although number of cases with severe CTS increased after 6 months, there were no cases with severe CTS at a year follow-up. *P* value: 0.001 approved statistically significant difference

Table 1 Number of bland scale electrophysiologic test changes in 100 CTS cases without considering any risk factor(s)

	Mild	Moderate	Severe
At the beginning	0	68	32
At 6-month follow-up	39	27	34
At 1-year follow-up	85	15	0

with positive effect of conservative treatment in moderate CTS and surgical release in severe CTS patients. Moreover, response to treatment after 1 year was better than after 6 months (P value < 0.05). This result indicates that the trend of response to treatment escalated over time.

Tables 3 and 4 demonstrate the response to treatment of four groups based on bland and five-point GAO scales at 6 months and a year follow-up. Although about 22% of moderate CTS patients with risk factors changed to mild CTS after 6 months of conservative treatment, about 75% showed mild CTS or complete remedy following one year (P value < 0.001). This result was about 30% at 6 months and about 95% at 1 year following conservative treatment in patients with moderate CTS without risk factors. None of moderate CTS patients with or without risk factors underwent surgery after 1 year of follow-up.

Although almost all patients with severe CTS, with or without risk factors, showed complete recovery or changes to mild CTS at 1 year postoperatively, the result was statistically significant for cases without risk factors

(P value = 0.002). No recurrence was seen in severe CTS patients after surgical release of the carpal tunnel.

Discussion

Management of different severities of CTS in patients with associated various risk factors is a debate topic in the literature [27, 28]. In our research, more satisfactory results were obtained in severe CTS cases treated operatively, as seen by increasing the number of cases with normal or mild CTS not only after 6 months but also after 1 year. In multiple recent studies, it has been proved that surgical release is more effective than conservative ones with extraordinary economic benefit [1, 29, 30]. Lee et al. showed significantly increased rate of the surgery in cases with more severe grades on EMG–NCV, in females and patients younger than 60 [31].

In surgically treated cases, we had more normal cases after 1 year in comparison with 6 months following the surgery. It is similar to what explained by Shi et al. [21] in a systematic review, superior function and relief of pain can be seen in surgical release of carpal tunnel after 1 year in comparison with 6-month postoperatively. Moreover, they recommended the necessity of several prognostic and risk factors for surgical treatment. In this study, we evaluated the prognostic factors for successful treatment of CTS, but we did not have any intervention on risk factors during the research period. Although the outcome of severe CTS cases with risk factors after surgical release was acceptable,

Table 2 Response to treatment based on the five-point GAO scale in 100 CTS cases without considering any risk factor(s)

	Worse	Unchanged	Slightly better	Much better	Completely treated	P value
At 6-month follow-up	11	17	22	31	19	0.001
At 1-year follow-up	0	1	11	41	47	

Table 3 Bland scale changes for the electromyography in moderate and severe CTS cases

	Response to treatment	Moderate CTS			Severe CTS		
		Total (68 cases)	With risk factor(s) (32 cases)	Without risk factor(s) (36 cases)	Total (32 cases)	With risk factor(s) (16 cases)	Without risk factor(s) (16 cases)
At 6-month follow-up	Normal	2	0	2	17	3	14
	Mild	16	7	9	15	13	2
	Moderate	39	21	18	0	0	0
	Severe	11	4	7	0	0	0
At 1-year follow-up	Normal	27	10	17	20	5	15
	Mild	31	14	17	12	11	1
	Moderate	10	8	2	0	0	0
	Severe	0	0	0	0	0	0
P value		< 0.001			0.002		

Table 4 Response to treatment based on the five-point GAO scale in moderate and severe CTS cases

	Response to treatment	Moderate CTS			Severe CTS		
		Total (68 cases)	With risk factor(s) (32 cases)	Without risk factor(s) (36 cases)	Total (32 cases)	With risk factor(s) (16 cases)	Without risk factor(s) (16 cases)
At 6-month follow-up	Worse	11 (16.2%)	4	7	0 (0.0%)	0	0
	Unchanged	17 (25.0%)	6	11	0 (0.0%)	0	0
	Slightly better	22 (32.4%)	15	7	0 (0.0%)	0	0
	Much better	16 (23.5%)	7	9	15 (46.9%)	13	2
	Completely treated	2 (2.9%)	0	2	17 (53.1%)	3	14
At 1-year follow-up	Worse	0 (0.0%)	0	0	0 (0.0%)	0	0
	Unchanged	1 (1.5%)	1	0	0 (0.0%)	0	0
	Slightly better	9 (13.2%)	7	2	2 (6.3%)	2	0
	Much better	31 (45.6%)	14	17	10 (31.3%)	9	1
	Completely treated	27 (39.7%)	10	17	20 (62.5%)	5	15
<i>P</i> value		<0.001			0.002		

cases without risk factors had superior results with faster improvement.

Different available conservative treatments are described in the literature. Steroid injection is one the most common and valuable choices [28, 32]. Physical therapy or manual therapy [33] based on neurodynamic techniques is a useful treatment only for mild to moderate forms of CTS [14]. We did not prescribe physical therapy because it is an individual-dependent procedure. Wrist splint is usually used as an adjunct to the other options [20]. Because our cases had moderate CTS and we wanted to eliminate the effect of individual-dependent variations of physical therapy, steroid injection in combination with night splint were prescribed for moderate CTS cases.

The patients with moderate CTS had satisfactory results with conservative treatment, but the effects of surgical release in severe cases were better. Although we did not assess the effects of operative treatment on moderate CTS cases, surgical release could be recommended for moderate CTS. This is in accordance with a suggestion by Wang [20].

In this study, we treated cases based on the EMG–NCV studies, without considering additional diagnostic modalities such as ultrasound. While no any single modality is the gold standard [20], we selected EMG–NCV in order to follow and compare the outcomes using bland scale. EMG–NCV could predict the functional and subjective outcomes [34]. Furthermore, EMG–NCV is a useful method to differentiate other related pathologies like cervical neuropathy or diabetic polyneuropathies.

In conclusion, conservative treatment for moderate CTS would be a good option and the final result may be seen

1 year later; however, its positive effect is quicker and better for moderate CTS cases without any predisposing risk factors. Surgical release of the carpal tunnel may be the best choice not only for severe CTS cases with risk factors but also for cases without risk factors. For obtaining consistent rapid result, it is recommended to do surgical release for all cases of moderate or severe CTS without considering risk factors, but more clinical researches are needed.

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Compliance with ethical standard

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of Jahrom University and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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