Surgical Treatment Results of Carpal Tunnel Syndrome in Patients with and without Type 2 Diabetes Mellitus

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SUMMARY

Introduction Carpal tunnel syndrome (CTS) is the most commonly seen peripheral nerve compression syndrome and CTS surgery is the most common surgery done for peripheral nerve compression syndromes. Type 2 diabetes mellitus (DM) is a systemic disease with a component of peripheral neuropathy.

Objective We aimed to investigate the effects of type 2 DM on functional results in type 2 DM patients who underwent carpal tunnel surgery.

Methods The study included 39 patients with carpal tunnel syndrome which was confirmed by electromyography. Twenty-one patients did not have DM, 18 patients had type 2 DM that were treated for DM and had regulated blood glucose levels. Assessments were done with the Boston scale. All operations were done by the same surgical team using the same surgical technique. Functional and symptomatic scores between the two groups were compared with the Mann-Whitney U test which is the non-parametric version of the Student's t test, and 95% confidence interval $p<0.05$, which is considered as statistically significant.

Results In patients with type 2 DM, preoperative mean Symptom Severity Score was 3.6±0.35 (2.9 to 4.2) in the last control mean Symptom Severity Score was 1.2±0.16 (1.0-1.7), and preoperative mean functional status score was 3.3±0.56 (2.3 to 4.5) and in the last control mean functional status score was 1.3±0.36 (1.0 to 2.4). The patients without DM, preoperative mean Symptom Severity Score was 3.5±0.45 (2.8 to 4.2) in the last control mean Symptom Severity Score was 1.2±0.19 (1.0 to 1.6), and preoperative functional status score was 3.2±0.47 (2.4 to 4.6) in the last control mean functional status score was 1.3±0.35 (1.0 to 2.5). There was no statistically significant difference between the two groups.

Conclusion Type 2 DM patients with regulated blood glucose levels can be operated without additional procedure during and after surgery for carpal tunnel syndrome like in carpal tunnel syndrome patients without DM.

Keywords: carpal tunnel; type 2 diabetes mellitus; Boston scale

INTRODUCTION

Carpal tunnel syndrome (CTS), due to compression of the median nerve in the carpal tunnel at the wrist, is the best known and the most common upper extremity compression neuropathy [1, 2]. The transverse carpal ligament has a compression on the median nerve on the wrist palmar surface in carpal tunnel syndrome. As a result of this compression the patient has hypoesthesia on the first, second, third and radial side of the forth finger of the hand.

Type 2 diabetes mellitus (DM) is a systemic disease with component of peripheral neuropathy. Conventional electrophysiological studies are widely used for the objective diagnosis of diabetic neuropathy. The physiological function of nerves can be evaluated quantitatively by nerve conduction study (NCS) [3, 4]. NCS abnormalities occur early in the course of type 2 DM, and the pattern of progression of peripheral neuropathy shows dependence on the length of the nerve fibers [5]. NCS shows complicated abnormalities of sensory, motor, and autonomic nervous systems [6]. In addition, NCS shows a mildly slow nerve conduction velocity and low amplitude in diabetic polyneuropathy, suggesting that the peripheral neuropathy of type 2 DM is primarily caused by axonal degeneration [7, 8].

There are two treatment modality for CTS, these are conservative and surgical treatment. Conservative treatment is an option for patients with early CTS. Splinting, local steroid injections, ultrasound, and the use of oral steroids are the methods of conservative treatment. Patients with evidence of median nerve denervation and in cases where conservative treatment has failed, surgical treatment is indicated [9]. Surgical treatment is release surgery for the transverse carpal ligament that compresses the median nerve. CTS is most commonly seen peripheral nerve compression syndrome and CTS surgery is most common surgery done for peripheral nerve compression syndromes.

OBJECTIVE

We aimed to investigate the effects of type 2 DM on functional results in type 2 DM patients who underwent carpal tunnel surgery and to

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compare the results of surgeries between diabetic CTS patients with non-diabetic CTS patients.

METHODS

Preoperatively, all patients were confirmed with the clinical examination and electromyography (EMG) that they had CTS. The patients were evaluated with the Boston scale pre-and postoperatively (Tables 1 and 2). All operations were performed by the same surgical team with the mini-open carpal tunnel release technique.Two-3 cm of longitudinal incision was done above the wrist flexor skin-fold and reached transverse carpal ligament and then release was done.

Thirty-nine patients were evaluated in our study. Eighteen patients had DM that were treated for DM and had regulated blood glucose levels. There were 7 male and 11 female patients. The mean age was 59.0 (51-68) years. Four patients were insulin dependent, while 14 patients were treated with oral anti-diabetic drugs. The duration of the type 2 DM was mean 5.4 (2-10) years. Five patients had CTS in both upper extremities but according to the EMG non-operated sides had mild involvement. One of the patients with DM had obesity. There was no additional pathology in DM patients. There were 21 patients in the other group with no additional pathology. There were 8 male and 13 female patients. The mean age was 56.3 (44-65) years. No problem was detected in both groups in postoperative follow-up period.

The Boston scale (BS) consists of 19 questions. There are multiple choice answers for each question. Every question is evaluated between 1 to 5 points. Point 1 is the best point for the functional capacity and represents mild symptoms, 5 points is the worst for the functional capacity and represent most severe symptoms. If a patient has a higher mean score it indicates insufficiency in functional capacity and severe symptoms. Symptom Severity Score is the total point of 11 questions. The average Symptom Severity Score is obtained by dividing Symptom Severity Score by the number of current question. Functional status score is the total point of 8 questions. The average functional status score is obtained by dividing the functional status score by the number of the current question.

Functional and symptomatic scores between the two groups were compared with the Mann-Whitney U test which is the non-parametric version of the Student's t test, and 95% confidence interval $p<0.05$ is considered as statistically significant.

RESULTS

Preoperative mean Symptom Severity Score was 3.6±0.35 (2.9 to 4.2) in the last control mean Symptom Severity Score was 1.2±0.16 (1.0-1.7), and preoperative mean functional status score was 3.3±0.56 (2.3 to 4.5) and in the last control mean functional status score was 1.3±0.36 (1.0 to 2.4) in the type 2 diabetic group. Preoperative mean

Table 1. Symptom Severity Scale (CTS)

The following questions refer to your symptoms for a typical 24-hour period during the last 2 weeks (circle one answer to each question).	
1. How severe is the hand or wrist pain that you have at night?	I do not have hand or wrist pain
	Mild pain
	Moderate pain
	Severe pain
	Very severe pain
2. How often did hand or wrist pain wake you up during a typical night over the past two weeks?	Never
	Once
	Two to three times
	Four or five times
	More than five times
3. Do you typically have pain in your hand or wrist during the daytime?	I never have pain during the day
	I have mild pain during the day
	I have moderate pain during the day
	I have severe pain during the day
	I have very severe pain during the day
4. How often do you have hand or wrist pain during the daytime?	Never
	Once or twice a day
	Three to five times a day
	More than five times a day
	The pain is constant
5. How long, on average, does an episode of pain last during the daytime?	I never get pain during the day
	Less than 10 minutes
	10 to 60 minutes
	Over 60 minutes
	The pain is constant throughout the day
6. Do you have numbness (loss of sensation) in your hand?	No
	I have mild numbness
	I have moderate numbness
	I have severe numbness
	I have very severe numbness
7. Do you have weakness in your hand or wrist?	No weakness
	Mild weakness
	Moderate weakness
	Severe weakness
	Very severe weakness
8. Do you have tingling sensations in your hand?	No tingling
	Mild tingling
	Moderate tingling
	Severe tingling
	Very severe tingling
9. How severe is numbness (loss of sensation) or tingling at night?	I have no numbness or tingling at night
	Mild
	Moderate
	Severe
	Very severe
10. How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	Never
	Once
	Two or three times
	Four or five times
	More than five times
11. Do you have difficulty with the grasping and using small objects such as keys or pens?	No difficulty
	Mild difficulty
	Moderate difficulty
	Severe difficulty
	Very severe difficulty

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Table 2. Functional Status Scale (CTS)

On a typical day during the past two weeks have hand and wrist symptoms caused you to have any difficulty doing activities listed below? Please circle one number that best describes your ability to do the activity.					
Activity	No difficulty	Mild difficulty	Moderate difficulty	Severe difficulty	Cannot do at all due to hand or wrist symptoms
Writing	1	2	3	4	5
Buttoning clothes	1	2	3	4	5
Holding a book while reading	1	2	3	4	5
Gripping a telephone handle	1	2	3	4	5
Opening jars	1	2	3	4	5
Household chores	1	2	3	4	5
Carrying grocery bags	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

Table 3. Preoperative and postoperative data of patients with and without diabetes mellitus (DM)

Patients	No.	Age (years)	Gender	Pre-operative symptom severity score	Post-operative symptom severity score	Pre-operative functional status score	Post operative functional status score	Duration of DM (years)	Type 1 DM
Diabetic patients	1	65	M	3.7	1.2	3.4	1.3	4	-
	2	68	M	2.9	1.0	2.3	1.0	3	-
	3	55	F	3.6	1.2	2.4	1.1	5	-
	4	58	M	4.2	1.3	4.5	2.4	8	+
	5	62	F	3.6	1.2	3.3	1.0	2	-
	6	61	F	4.2	1.2	3.6	1.2	8	-
	7	57	F	4.0	1.7	4.0	2.0	10	+
	8	62	F	3.6	1.2	3.8	1.5	4	-
	9	64	M	3.6	1.0	3.0	1.4	5	-
	10	52	F	3.6	1.0	3.4	1.2	4	-
	11	54	F	3.6	1.3	3.4	1.2	6	-
	12	60	M	3.4	1.2	3.2	1.3	8	+
	13	51	F	3.4	1.2	3.4	1.0	3	-
	14	67	F	3.0	1.0	3.0	1.2	8	-
	15	52	F	3.6	1.1	3.6	1.0	5	-
	16	63	M	3.6	1.4	3.0	1.2	9	+
	17	54	F	4.0	1.2	3.6	1.4	2	-
	18	57	M	3.2	1.2	2.4	1.0	4	-
Nondiabetic patients	1	52	F	3.2	1.0	3.0	1.0	/	/
	2	48	F	4.0	1.2	3.2	1.2	/	/
	3	62	M	4.2	1.6	4.0	2.5	/	/
	4	44	F	3.0	1.4	3.2	2.0	/	/
	5	58	M	3.4	1.3	3.2	1.3	/	/
	6	62	F	2.8	1.0	2.4	1.2	/	/
	7	58	F	3.6	1.4	3.0	1.4	/	/
	8	64	F	4.0	1.0	3.2	1.0	/	/
	9	55	M	4.2	1.0	4.6	1.2	/	/
	10	46	F	3.5	1.4	3.0	1.4	/	/
	11	51	F	3.0	1.2	2.8	1.2	/	/
	12	55	M	3.8	1.0	3.2	1.0	/	/
	13	60	M	3.8	1.0	3.2	1.0	/	/
	14	63	F	3.6	1.2	3.0	1.4	/	/
	15	47	F	3.2	1.4	2.8	1.4	/	/
	16	57	M	3.0	1.1	2.8	1.1	/	/
	17	55	M	3.0	1.4	2.8	1.2	/	/
	18	65	F	4.0	1.0	3.2	1.2	/	/
	19	64	F	4.0	1.0	3.8	1.0	/	/
	20	61	M	3.2	1.2	3.6	1.2	/	/
	21	56	F	3.0	1.4	3.2	1.4	/	/

M – male; F – female

Symptom Severity Score was 3.5±0.45 (2.8 to 4.2) in the last control mean Symptom Severity Score was 1.2±0.19 (1.0 to 1.6), and preoperative functional status score was 3.2±0.47 (2.4 to 4.6) in the last control mean functional status score was 1.3±0.35 (1.0 to 2.5) in the non-diabetic group. 2 of the patients who were insulin dependent in the type 2 diabetic group had mild improvement after surgical intervention in their last control (Table 3).

The values of the two groups were compared statistically. There was no significant difference between the results of two groups. Average follow-up period was 7 months (6-12) in the type 2 diabetic group. Mean follow-up period was 8 months (6-14) in the non-diabetic group. Prophylactic antibiotics were not given to the patients in both groups after surgery. Infection was not detected during the follow-up time. There was no other complication that was detected in the patients after surgery.

DISCUSSION

All open surgical techniques with different sizes of incisions and arthroscopic interventions remove the pressure on the median nerve by release are effective in symptomatic relief and functional improvement [10-14].

Zyluk et Puchalski [15] performed carpal tunnel surgery in 345 patients without DM and 41 DM patients in their study. They mentioned that all patients in both groups benefited from surgery in similar proportions over the 6-month controls after surgery. According to the results of our study there was no statistically significant difference between the results of two groups. The patients in both groups benefited from surgery in similar proportions according to our study. Our results are similar with the results of Zyluk et Puchalski [15].

Gamstedt et al. [16] demonstrated 20% of patients who had CTS, Dupuytren's contracture, flexor tenosynovitis and limitation of the range of motion (ROM) in a cross-sectional study with 100 diabetic patients. There is a significant relationship between the duration of diabetes hand anomalies. There is no significant relationship between other diabetic complications, metabolic control and hand anomalies. The prevalence of hand anomalies are high in DM and this prevalence increases with duration of diabetes [16]. The patients operated for CTS with type 2 DM had no additional hand pathology in our study. Only CTS release surgeries were done in patients with type 2 DM; for this reason our study is limited in regard to offering information about other hand pathologies in diabetic patients.

According to the study of Tosti et al. [17] 4 most commonly performed procedures involving the hand were carpal tunnel release, trigger finger release, mass excision, and first dorsal compartment release. The overall infection rate was 0.66%. All infections were considered superficial, and none required surgical management. In patients who received antibiotic prophylaxis (n=212), the infection rate was 0.47%. In those who did not receive prophylaxis (n=388) the infection rate was 0.77%. These differences were not statistically significant (p=1.00) [17]. In our patient we applied a single dose of preoperative antibiotic prophylaxis. Postsurgical antibiotic prophylaxis was not applied in any of the patients reported in this study. Deep and superficial infection was not detected during the follow-up period. As the number of patients in our study was lower, this restricted us from determining infection rates between the two groups.

The most commonly used questionnaire for treatment results is the Boston scale which was defined by Levine et al. [18]. Akman et al. [19] evaluated their patients in whom CTS surgery was performed with electrophysiological study and Boston scale before and after surgical treatment. They reported that EMG examination after surgery provided no additional benefit; for this reason the Boston scale is sufficient for the follow-up evaluation [19]. We evaluated our patients with the Boston scale which contained functional status and symptom severity scale in post-operative follow-ups. We detected a statistically significant improvement in both groups of patients. No EMG was done in the patients during the postoperative period.

CONCLUSION

There was no statistically significant difference between the functional and clinical outcome scores between the two groups after surgery. All patients in both groups stated that they benefited from surgery but 2 of the insulin dependent diabetic patients had mild improvement. Diabetic patients with regulated blood glucose levels can be operated on without additional procedure during and after surgery for carpal tunnel syndrome.

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Резултати хируршког лечења синдрома карпалног тунела код болесника са дијабетес мелитусом тип 2 и без њега

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КРАТАК САДРЖАЈ

Увод Синдром карпалног тунела (СКТ) је најчешћа локализована компресивна лезија периферног нерва, а операција СКТ је најчешћа хируршка интервенција у лечењу синдрома компресије периферног нерва. Дијабетес мелитус (ДМ) тип 2 је системско обољење с компонентом периферне неуропатије.

Циљ рада Циљ истраживања је био да се испита утицај ДМ тип 2 на функционалне резултате хируршки лечених болесника са СКТ и ДМ тип 2.

Методе рада Испитивањем је обухваћено 39 болесника са СКТ који је дијагностикован електромиографијом. Код 21 болесника није забележен ДМ тип 2, док је 18 испитаника лечено од овог обољења и имало регулисане вредности глукозе у крви. Процена обољења је извршена применом Бостонског теста. Операцију свих болесника извео је исти хируршки тим применом исте хируршке технике. У анализи упоређивања скора функционалног и симптоматског стања између две групе испитаника примењен је Ман–Витнијев (*Mann–Whitney*) *U*-тест, који је непараметријска верзија Студентовог *t*-теста. Утврђен је 95-процентни интервал поверења на $p<0,05$, што се сматра статистички значајним.

Резултати Код болесника са ДМ тип 2 средња вредност скора тежине симптома пре операције била је 3,6±0,35 (распон 2,9–4,2), а на последњем контролном прегледу 1,2±0,16 (распон 1,0–1,7). Средња вредност скора функционалног статуса пре операције била је 3,3±0,56 (распон 2,3–4,5), а на последњем прегледу 1,3±0,36 (распон 1,0–2,4). Код болесника без ДМ средња вредност скора тежине симптома пре операције била је 3,5±0,45 (распон 2,8–4,2), а на последњем контролном прегледу 1,2±0,19 (распон 1,0–1,6). Средња вредност скора функционалног статуса пре операције код ових испитаника била је 3,2±0,47 (распон 2,4–4,6), а на последњем контролном прегледу 1,3±0,35 (распон 1,0–2,5). Статистички значајна разлика између две посматране групе испитаника није утврђена.

Закључак Болесници са ДМ тип 2 и регулисаним вредностима глукозе у крви могу да се оперишу без примене додатних поступака током или након операције СКТ, а исто важи и за болеснике без ДМ.

Кључне речи: карпални тунел; дијабетес мелитус тип 2; Бостонски тест

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