



## The effects of diabetes on symptoms of carpal tunnel syndrome treated with mini-open surgery

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This study aimed to evaluate the influence of type II diabetes mellitus (DM) on the postoperative outcomes of mini-open carpal tunnel syndrome (CTS) surgery. A total of 99 hands in 74 patients were included in the study. Of these, 36 patients (54 hands) had type II DM (Group A), and 38 patients (45 hands) had idiopathic CTS (Group B). Mini-open carpal tunnel release surgery was performed on all the hands. The night pain, weakness, paraesthesia, numbness complaints were significantly improved in both groups after surgery. However, thenar atrophy was improved significantly only in group A. Night pain, weakness, paraesthesia, numbness, and pillar pain were significantly worse in Group A than in Group B on postoperative examination. Postoperatively, Tinnel and Phalen tests were positive in 32 hands in Group A and 6 hands in Group B. Persistence of symptoms in diabetic patients was found to be more prevalent compared to non-diabetic controls after mini-open carpal tunnel release.

**Keywords :** carpal tunnel syndrome ; diabetes mellitus ; mini-open surgery ; pillar pain.

### INTRODUCTION

Compression of the median nerve in the carpal tunnel is the most common peripheral entrapment neuropathy (4,6,8,11,14) ; carpal tunnel syndrome (CTS) affects approximately 3-6% of adults in the general population (11). Among the risk factors, female gender, obesity, high body mass index, diabe-

tes mellitus (DM), rheumatoid arthritis, and hypothyroidism are the most prominent (2). Trauma, repeated maneuvers, and pregnancy are other important risk factors associated with increased incidence of CTS (11).

The surgical options for the release of the transverse carpal ligament in the treatment of CTS are conventional open decompression, minimally invasive open decompression, and decompression under wrist arthroscopy. The current gold standard and most commonly performed techniques are mini-open and open carpal tunnel release (CTR) surgeries.

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Mini-open CTR requires a smaller incision than standard open CTR surgery and minimizes healing time and scar formation. It also allows the surgeon to view the ligament directly during the surgery to minimize danger to the nerve itself. The most frequent complications of CTR are neuroma of the palmar cutaneous branch of the median nerve, hypertrophic scars, dysaesthesia after multiple procedures to release the carpal tunnel, joint stiffness, failure to relieve symptoms, and pillar pain (20).

The aim of the present study was to evaluate the effects of type II diabetes mellitus on mini-open CTR release surgery in terms of relieving symptoms, including night pain, thenar atrophy, weakness, paraesthesia, numbness, and pillar pain, and to compare the outcome in these patients with those in non-diabetic controls.

## PATIENTS AND METHODS

Approval from the Institutional Review Board was obtained. A search of a computerized patient database was performed to identify all patients with CTS who underwent mini-open CTR between January 2009 and January 2012. The year 2012 was selected to ensure a minimum one-year follow-up. A total of 74 patients (99 CTS hands) were included in the study. Of these, 36 patients (54 CTS hands) had type II DM (Group A) and 38 patients (45 CTS hands) were non-diabetic (Group B). Diabetes was considered present at baseline if the patient had a history of diabetes or a baseline fasting blood glucose  $\geq 126$  mg/dl. Patients with impaired fasting glucose and fasting blood glucose  $< 126$  mg/dl were considered normal. Of these, 4 diabetic patients were on insulin treatment and the other 50 patients were on oral anti-diabetic treatment.

The CTS diagnosis was made by clinical examination and electromyography in all patients. Patients unresponsive to conservative treatment with wrist brace and anti-inflammatory medicine had CTR surgery. Patients who had at least 12 months of postoperative follow-up were included in the study. Patients with posttraumatic CTS, anatomic deformity of the wrist, obesity, hypothyroidism, a space-occupying mass in the carpal tunnel, cervical pathology, or multiple surgeries were excluded from the study. Retrospective chart reviews of eligible patients were conducted, and the following measures were noted: median nerve sensory and motor examination, thenar atrophy, Tinnel and Phalen tests, difficulty in grasping,

and night pain. The patients were called back and the same measures were evaluated again, as well as pillar pain.

## Surgical technique

All patients underwent mini-open CTS surgery using local anaesthesia under sedation. After careful skin preparation and draping, the incision was marked along the ulnar border of the major thenar crease in line with the radial border of the ring finger. The incision began just distal to the distal wrist crease and extended no farther than Kaplan's cardinal line (9) which extends along the distal border of the outstretched thumb obliquely toward the pisiform. After inflation of a tourniquet, a longitudinal incision approximately 3 cm in length was made. The skin, subcutaneous tissue, palmar fascia, and transverse carpal ligament were released, and a median nerve neurolysis with a simple longitudinal incision on the epineurium was performed in all cases. The tourniquet was then released, and meticulous haemostasis was obtained with bipolar coagulation set on low current. The skin was closed with interrupted 4-0 prolene sutures. The procedure was performed in an outpatient setting and completed in 9-15 minutes.

## Statistical analysis

Data analysis was performed using SPSS statistical software version 15.0 for Windows (SPSS Inc., Chicago, USA). The data are shown as mean  $\pm$  standard deviation for continuous variables, median (minimum–maximum) for ordinal ones, and frequency with percent for categorical ones. Means were compared using Student's t test. Categorical comparisons were made using chi-square or Fisher's exact test, where appropriate. Difference of categorical variables between the preoperative and postoperative period was evaluated using the McNemar test. A p value less than 0.05 was considered statistically significant.

## RESULTS

The mean age of the patients was  $50.9 \pm 12.2$  years in Group A and  $51.4 \pm 9.7$  years in Group B. There was no statistically significant difference between groups in terms of age ( $p = 0.8$ ). There were 34 (63%) females and 20 (37%) males in Group A, and 37 (82.2%) females and 8 (17.8%) males in Group B ( $p = 0.044$ ). In Group A, 18 patients had bilateral

CTS, 11 patients had CTS in the right hand, and 7 patients in the left hand. None of the patients in Group A had diabetic polyneuropathy. In Group B, 7 patients had bilateral CTS, 13 patients had CTS in the right hand, and 18 patients in the left hand. There was no difference between groups in terms of laterality ( $p = 0.8$ ). The mean follow-up was 19.5 months in Group A and 20 months in Group B ( $p = 0.6$ ).

None of the patients in either group had intraoperative or early postoperative complications. Preoperatively, all the patients in Group A and 42 (93.3%) patients in Group B complained of night pain ( $p = 0.9$ ). Postoperatively, there was night pain in 26 hands in Group A and none in Group B ( $p < 0.001$ ). The night pain complaint was significantly reduced after CTR in both groups ( $p < 0.001$  for both).

Preoperative thenar atrophy was found in 16 hands in Group A and 12 hands in Group B. Those numbers were reduced to 10 and 7 hands after CTR, respectively. There was no statistically significant difference between the groups in terms of preoperative or postoperative atrophy ( $p = 0.7$ ). The change in the numbers of hands with thenar atrophy was significant in Group A ( $p = 0.03$ ), but not in Group B ( $p = 0.6$ ).

The frequency of weakness, paraesthesia, and numbness in the preoperative and postoperative periods is shown in Table I. There was a statistically significant difference between groups in terms of weakness and paraesthesia, both preoperatively ( $p = 0.03$  for both) and postoperatively ( $p < 0.001$  for both). There was no difference between the groups preoperatively in terms of numbness ( $p = 0.2$ ). Postoperatively, Group A showed a higher incidence of weakness compared to Group B ( $p < 0.001$ ). Pillar pain was present in 27 hands (50%) in Group A and 4 hands (8.9%) in Group B. There was a statistically significant difference between the groups in terms of pillar pain ( $p < 0.001$ ).

## DISCUSSION

The most commonly performed surgical technique in the treatment of CTS is relieving the median nerve via cutting open the transverse carpal

ligament. Sufficient release of the carpal ligament is essential, and possible anatomic variations should be kept in mind. Postoperative complications, including excessive scar tissue, injury to the palmar motor branch of the median nerve, and unsatisfactory release, may result in an increase in the patient's complaints (1). In the present study, we did not encounter such problems in either study group.

Pillar pain is generally described as tenderness in the hypothenar and thenar regions (17). The actual mechanism and cause of pillar pain is still elusive and controversial (13). Pillar pain and scar tenderness are the most common complications of CTS (8). Recently, endoscopic carpal tunnel surgery has gained popularity, due to the development of microsurgical equipment. The advantages of endoscopic carpal tunnel surgery are less scar tissue, less pain in the early postoperative period, more rapid recovery of wrist strength, and shorter length of postoperative time off work (5). Lee *et al* reported that their endoscopic surgery technique led to less scar tissue and pillar pain and more rapid wound healing compared to published series of endoscopic carpal tunnel release (12). However, besides a long learning curve, the need for special equipment, and higher costs (3,18), certain complications, including partial or complete median and ulnar nerve lacerations, flexor tendon injuries, and vascular problems, have been reported in endoscopic carpal tunnel surgery (5). We did not experience any complications in our mini-open CTR series of 99 hands.

In contrast, Wong *et al* reported a higher incidence of pillar pain (53%) in endoscopic carpal tunnel surgery compared to limited-open carpal tunnel surgery (30%) (21). However, Polvsen *et al* found a 25% incidence of pillar pain at three months postoperatively in patients who underwent open carpal tunnel decompression (16). Yunk *et al* performed a limited palmar incision technique in their cases and followed them for about 18 months (22). The authors reported complete or significant relief of paraesthesia symptoms in 91% of their patients. Pillar pain was present in 48% of the patients four weeks postoperatively and in 7% at the last follow-up visit. However, Yunk *et al* included only non-diabetic patients with CTS who underwent carpal tunnel release through a limited palmar incision. In the

Table I. — Preoperative and postoperative frequency of symptoms per hand in both groups

Parameters	Group A (n = 54)	Group B (n = 45)	P value†
Night pain			
Pre	54 (100%)	42 (93.3%)	0.09
Post	26 (48.1%) < 0.001*	0 (0%) < 0.001*	< 0.001
Atrophy			
Pre	16 (29.6%)	12 (26.7%)	0.7
Post	10 (18.5%) 0.03*	7 (15.6%) 0.06*	0.7
Weakness			
Pre	48 (88.9%)	32 (71.1%)	0.03
Post	19 (35.2%) < 0.001*	1 (2.2%) < 0.001*	< 0.001
Paresthesia			
Pre	48 (88.9%)	45 (100%)	0.02
Post	22 (40.7%) < 0.001*	4 (8.9%) < 0.001*	< 0.001
Tinnel			
Pre	54 (100%)	45 (100%)	
Post	32 (59.3%) < 0.001*	6 (13.3%) < 0.001*	< 0.001
Phallen			
Pre	54 (100%)	45 (100%)	
Post	32 (59.3%) < 0.001*	5 (11.1%) < 0.001*	< 0.001
Numbness			
Pre	54 (100%)	43 (95.6%)	0.2
Post	35 (64.8%) < 0.001*	3 (6.7%) < 0.001*	< 0.001

\* , indicates p value of preoperative and postoperative difference within the group ; † , indicates preoperative or postoperative difference between the groups.

present study, we detected pillar pain in 9% of the non-diabetic patients and 50% of the diabetic patients. Increased frequency of pillar pain in our diabetic group may be due to increased inflammation or delayed wound healing related with diabetes mellitus in those patients. Thomsen *et al* did not find a significant difference between type 1 and type 2 diabetic patients after CTR in terms of pillar pain (19). The current literature does not show a consensus about the surgical method to be used or the incidence of postoperative pillar pain in CTS. Therefore, further studies are necessary to clarify postop-

erative satisfaction in CTS patients according to the surgical modality.

Boya *et al* evaluated pillar pain using a table test and found that patients who underwent open carpal tunnel release had a pillar pain incidence of 12.7% (4). Kluge *et al* studied patients with at least ten months of follow-up and found that pillar pain was present in 4% and scar tenderness in 19% (10) ; the authors reported decreased pillar pain and scar tenderness with time. In contrast, we found approximately 50% pillar pain in diabetic patients who had mini-open CTR surgery in the present study.

However, the rates of pillar pain in the non-diabetic controls were similar to those in literature.

Both Phalen (15) and Choi and Ahn (7) believed that diabetes did not adversely affect the surgical outcome, with Choi and Ahn showing improvement (with good-to-excellent results) in 14 out of 19 diabetic patients (74%). In the present study, the non-diabetic group exhibited fewer and milder complaints and pillar pain than the diabetic group, which suggests a possible association between diabetes and pillar pain. The major limitations of the present study are its retrospective nature and relatively small sample size. Further prospective studies are necessary to address the effects of diabetes on CTS surgery results.

In conclusion, postoperative recurrence of symptoms such as pillar pain and thenar atrophy in patients with carpal tunnel syndrome is likely to be higher in diabetic individuals compared to non-diabetic controls. Patients with diabetes who are scheduled for carpal tunnel release surgery should be warned about the possible interference of their diabetes with the results of the surgical procedure.

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