

Splinting after Carpal Tunnel Surgical Treatment: Does It Really Matter?

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ABSTRACT

Background: Splinting of the wrist after carpal tunnel release (CTR) has been practiced by many surgeons especially in North America. The main reason was to prevent possible adverse events of bowstringing of flexor tendons and the median nerve, pillar pain, entrapment of the median nerve in scar tissue and wound dehiscence. Studies on the effect of splinting after standard CTR had dismal results. The duration of splinting in standard CTR has been either too long (for 2-4 weeks) or too short (48 hours only).

Objective: The aim of our study was to compare the effects of post-operative splinting for duration of one week with no splinting. **Patients and Methods:** All 20 of our patients underwent a standardized open CTR. Post operatively, they were randomized into a splinted (n=10) and a non-splinted (n=10) group. The splint was kept for 2 weeks. Patients were reviewed at regular intervals of one week, two weeks and three months. At each follow up, these patients were clinically assessed for outcome of the Boston questionnaire.

Results: All patients presented with significant improvement in the post-operative evaluation within each group. However, there was no significant difference between the two groups for any of the outcome measurements at sequential and at final follow-up. **Conclusion:** We concluded that wrist splinting in the immediate post-operative period has no advantage when compared with the non-splinting wrist after a standard open carpal tunnel release.

Keywords: Carpal tunnel syndrome, carpal tunnel release, wrist splint, open carpal tunnel release, nerve compression.

INTRODUCTION

The carpal tunnel syndrome (CTS) is considered the most common entrapment neuropathy of the upper extremity caused by compression of the median nerve at the wrist. It occurs most often in patients between 30 and 60 years old and five times more common in women than in men⁽¹⁾. Variety of conditions may be associated with carpal tunnel syndrome. These include pregnancy, inflammatory arthritis, colles' fracture, amyloidosis, hypothyroidism, diabetes mellitus, acromegaly and use of corticosteroids and estrogen⁽²⁾.

Carpal tunnel syndrome generally produces pain, paraesthesia, numbness or tingling involving the palmar aspect of the thumb, index finger, middle finger, and radial half of the ring finger. Symptoms are worse at night and often wake the patient⁽³⁾.

The patient with mild symptoms of CTS can be managed with conservative treatment, particularly local injection of steroids and splinting. However, in moderate and severe cases, surgery is the only treatment that provides cure. The basic principle of surgery is to increase the volume of the carpal tunnel by dividing transverse carpal ligament to release the pressure on the median nerve^(5,6). Post-operative wrist splinting from a neutral position to 15° of extension places the carpal tunnel in its most open position. This allows maximal circulation to the median nerve, prevents compression during activities, bowstringing of flexor tendons, wound dehiscence, reduction of pillar pain and entrapment of the median nerve within the surgical incision⁽⁷⁻⁸⁾. One to two weeks of splinting have been recommended following endoscopic release⁽⁹⁻¹¹⁾ and one to three weeks following open carpal tunnel release⁽¹²⁾. A survey of American hand

surgeons found that 81% of them splinted their patients' wrists for two to four weeks following carpal tunnel surgery⁽¹¹⁾. Cook *et al.*⁽¹³⁾ advocated splinting for one week as a precaution against the complications of tendon bowstringing and nerve entrapment in the scar.

AIM OF THE WORK

The aim of our study was to compare the effects of post-operative splinting for duration of one week with no splinting.

Hypothesis: Post-operative wrist splinting in 15° of extension places the carpal tunnel in its most open position. This allows good circulation to the median nerve and prevents compression during activities, bowstringing of flexor tendons, wound dehiscence, reduction of pain and entrapment of the median nerve within the surgical incision.

PATIENTS AND METHODS

The material of this study compromised 20 patients all of them suffered from idiopathic CTS. All patients presented at the Outpatient Clinic of Abo Al Mattamer General Hospital. All patients were treated at the same hospital in the period between October 2016 to June 2017. All cases were subjected to clinical and electrophysiological examinations.

Inclusion criteria: Both genders will be included and Idiopathic carpal tunnel syndrome.

Exclusion criteria: Any recognized cause of carpal tunnel syndrome such as inflammatory arthritis, diabetes, hypothyroidism, congestive cardiac failure, peripheral nerve condition (double crush pathology) or pregnancy.

Outcome Measures: Results are assessed following The Boston questionnaire. This is a disease-specific

questionnaire, which has two tables. The first table assesses the severity of symptoms (Table 1) and the second table assesses functional status (Table 2).

Operative Technique: patient lies supine; tourniquet was applied to the upper arm to control bleeding in the operative field. All operations were performed under local anesthesia with light sedation. A longitudinal incision in the base of the palm is used. The incision is made in line with the flexed ring finger. The intersection of this longitudinal line with the Kaplan line (a line parallel to the ulnar aspect of the extended thumb) marks the distal extent of the incision. Proximally, the incision ends a few millimeters distal to the distal wrist flexion crease. The TCL is divided sharply after protecting content of carpal tunnel. The skin incision is closed by interrupted sutures.

Post-operative protocol: Patients were randomized into two groups immediately post-operative. Group A: will receive a volar plaster splint for two weeks with the wrist in a 15° extended position with full finger motion allowed. The splints will extend just below the elbow until the metacarpophalangeal level allowing tendon and nerve gliding exercises. Group B: will receive a soft bulky dressing for two week with unrestricted active motion. **Approval of the Ethical Committee and a written consent from each patient were obtained.**

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (χ^2) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following:
 - Probability (P-value)
 - P-value <0.05 was considered significant.
 - P-value <0.001 was considered as highly significant.
 - P-value >0.05 was considered insignificant.

RESULTS

The material of this study compromised a total of 20 patients all of them suffered from idiopathic CTS. Age of the patients of this study ranged between 20 and 52 years old with a mean of 37.6 ± 8.3 years (Table 1). All patients of our study were females (100%) with no incidence in males, this was only by chance. Seventy-five percent (75%) of our patients were affected in right hand while 25% of our patients were affected in left hand. (Table 2). Symptoms presented for duration ranged from 6 to 24 months with a mean of 12.35 ± 5.8 months.

Table (1): Age distribution among the studied patients.

| Variable | Minimum | Maximum | Mean \pm S.D |
|------------|---------|---------|----------------|
| Age(years) | 25 | 52 | 37.6 ± 8.3 |

Table (2): Operated hand in the studied patients.

| Operated hand | No. of patients | Percentage |
|---------------|-----------------|------------|
| Right hand | 15 | 75% |
| Left hand | 5 | 25% |
| Total | 20 | 100% |

Subjective evaluation of symptom severity (Boston symptom score): Boston score is a self-administered questionnaire for the assessment of severity of symptoms and functional status in patients who have carpal tunnel syndrome. **Boston symptom score:** It included eleven questions with multiple-choice responses regarding different attributes of pain, tingling and numbness, with each answer scoring between 1 point (normal) and 5 points (most severe). The over-all symptom severity score is calculated as the mean of the scores for the eleven individual items.

Pre-operative score: It ranged from 1.9 to 3.9 for splinted patients and from 2.18 to 3.81 for non-splinted patients with a mean of 2.8 ± 0.61 for splinted and 2.87 ± 0.55 for non-splinted patients of our study (table 3).

Boston function score: It looks at eight functions and scores the ability to perform each. The answers were rated from 1 point (no difficulty with the activity) to 5 points (can't perform the activity at all). Three of these functions (writing, gripping a telephone and opening jars) are performed usually by the dominant hand. The over-all score for functional status was calculated as the mean of all eight items. Items that were left unanswered or were not applicable were not included in the calculation of the over-all score.

Pre-operative score: It ranged from 1.88 to 3.63 for splinted patients and from 1.38 to 3.5 for non-splinted patients with a mean of 2.6 ± 0.68 for splinted and 2.7 ± 0.67 for non-splinted patients of our study (table 3).

Post-operative Boston symptom score: During the follow up period, Boston symptom scores for splinted patients were $1.93 \pm .36$, $1.42 \pm .2$, $1.06 \pm .09$, $1.01 \pm .03$ (2nd, 4th, 8th and 12th post-operative weeks respectively), compared to 2.8 ± 0.61 pre-operatively. In addition, $2.18 \pm .34$, $1.65 \pm .29$, $1.17 \pm .15$, $1.03 \pm .045$ (2nd, 4th, 8th and 12th post-operative weeks respectively), compared to 2.87 ± 0.55 pre-operatively for non-splinted patients of our study (table 4,5).

Post-operative Boston function score: In our patients the mean value of Boston function scores were 1.68 ± 0.53 , 1.09 ± 0.12 and 1.05 ± 0.11 (4th, 8th and 12th post-operative weeks respectively) compared to 2.6 ± 0.68 for splinted pre-operative. Besides, 1.87 ± 0.42 , 1.26 ± 0.09 and 1.025 ± 0.05 (4th, 8th and 12th post-operative weeks respectively) compared to 2.7 ± 0.67 for non-splinted patients pre-operative. Table (4, 5): Outcome data comparing splinted and non-splinted Boston Score pre-operatively (table 4 5).

Table (3): Outcome data comparing splinted and non-splinted Boston score pre-operatively.

| Pre-operative | Splinted | Non-splinted | t value | P value |
|------------------------|------------|--------------|---------|---------|
| Symptom severity score | 2.8 ± 0.61 | 2.87 ± 0.55 | 0.27 | 0.79 |
| Hand function score | 2.6 ± 0.68 | 2.7 ± 0.67 | 0.33 | 0.74 |

Table (4): Outcome data comparing post-operative data for splinted and non-splinted patients.

| Post-operative | Splinted | Non-splinted | t value | P value |
|-------------------------|-------------|--------------|---------|---------|
| Symptoms severity score | 1.01 ± 0.03 | 1.03 ± .045 | 1.17 | 0.26 |
| Hand function score | 1.05 ± 0.11 | 1.025 ± 0.05 | 0.65 | 0.52 |

Table (5): Outcome data comparing pre-operative and post-operative findings for Boston Score.

| | Pre-operative | Post-operative | t value | P value |
|--------------------------------------|---------------|----------------|---------|---------|
| Splinted Symptoms severity score | 2.8 ± 0.61 | 1.01 ± 0.03 | 9.27 | 0.0001 |
| Splinted hand function score | 2.6 ± 0.68 | 1.05 ± 0.11 | 7.11 | 0.0001 |
| Non-splinted symptoms severity score | 2.87 ± 0.55 | 1.03 ± .045 | 10.31 | 0.0001 |
| Non splinted hand function score | 2.7 ± 0.67 | 1.025 ± 0.05 | 7.88 | 0.0001 |

DISCUSSION

Carpal tunnel syndrome (CTS) is a common compression neuropathy of the upper extremity. The annual incidence of CTS in primary care in the UK and the Netherlands is estimated at approximately 90 per 100,000 new presentations in men and 193 to 280 per 100,000 new presentations in women⁽¹⁾.

CTS is caused by compression of the median nerve in the carpal tunnel at the wrist and produces pain, paraesthesia and hypoaesthesia in the hand⁽³⁾.

The severity of CTS ranges from mild to severe. Mild CTS presents as intermittent symptoms of paraesthesia and numbness, often at night. Severe CTS may cause permanent atrophy of the thenar muscles innervated by the median nerve and permanent loss of sensation in the median nerve distribution in the hand. CTS is a clinical diagnosis. Electrophysiological tests (nerve conduction studies) are performed to support the clinical diagnosis⁽⁴⁾.

In the United States approximately 40% of all CTS cases are treated surgically.

Post-operative wrist splinting from a neutral position to 15° of extension places the carpal tunnel in its most open position. This allows maximal circulation to the median nerve, prevents compression during activities, bowstringing of flexor tendons, wound dehiscence, reduction of pillar pain and entrapment of the median nerve within the surgical incision. A survey of American hand surgeons found that 81% of them splinted their patients' wrists for two to four weeks following carpal tunnel surgery^(9,10).

The material of this study compromised a total of 20 patients all of them suffered from CTS. Patients were randomized into two groups

immediately post-operative, Group (A) Received a volar plaster splint for two weeks with the wrist in a 15° extended position with full finger motion allowed. The splints were extended just below the elbow till the metacarpophalangeal level allowing tendon and nerve gliding exercises. Group (B) received a soft bulky dressing for two week with unrestricted active motion. All patients were treated at the period between October 2016 to June 2017.

Ages of the patients of this study ranged 25 and 52 years old with a mean of 37.6 ± 8.3 years. This result was in agreement with **Aslani et al.**⁽¹⁴⁾, who found a mean age of 50.3 years in patients of his study⁽¹⁴⁾.

All patients in our study were females. This disagrees with **Aslani et al.**⁽¹⁴⁾, where females were more commonly affected (77%) than males (23%).

Our results showed that the right hand is the most affected side (75%). Our results disagree with **Cellocco et al.**⁽¹⁵⁾ who found in their study that the lesion is bilaterally affection 48% of patients. Also, **Rab et al.**⁽¹⁶⁾ found bilateral affection of his patients. But significantly more often began or was more strongly expressed in the dominant hand.

In our study, examination of patients showed that all gave positive Phalen's sign, Tinel's sign as well as the presence of thenar muscles atrophy. This was in agreement with **Mintalucci et al.**⁽¹⁷⁾ and **Yüçetaş et al.**⁽¹⁸⁾, who found in their studies a sensitivity of 83% and specificity of 98% for Phalen's sign in diagnosis of CTS as well as a sensitivity of 73% and specificity of 94% of Tinel's sign in diagnosis of CTS. Also, **Braun et al.**⁽¹⁹⁾ found a good relation between the advancement of the disease and the presence of thenar muscles atrophy. Our results also were in agreement with **Aslani et al.**

⁽¹⁴⁾ who found a positive Phalen's sign, positive Tinel's sign, numbness and tingling sensation in patients of his study.

Our results also were in agreement with **Bury et al.** ⁽²⁰⁾ who compared two week of post-operative wrist splinting versus a bulky dressing after 43 open carpal tunnel releases. There were no significant differences between the two groups. Evaluation included subjective parameters of patient satisfaction and objective parameters of grip and lateral pinch strength complication rates and digital and wrist ranges of motion.

Also **Finsen et al.** ⁽²¹⁾ reported no significant differences between post-operative immobilization and non-immobilization after open carpal tunnel release in 82 wrists. The splint was used for four weeks and pain and scar discomfort were evaluated through a visual analogue scale and the grip and key pinch strength.

CONCLUSION

Our study concluded that wrist splinting for two weeks post-operatively had no significant difference compared to non-splinted wrists in patients with standard open carpal tunnel surgical treatment.

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