

Functional Outcome of Mini-Open Carpal Tunnel Release in Carpal Tunnel Syndrome

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ABSTRACT

Introduction: Carpal tunnel syndrome is the most common compression neuropathy in clinical practice and is also the most extensively studied. In Mini-open carpal tunnel release, the transverse carpal ligament is transected using a small open cut at the volar aspect of the proximal palm. The objectives of this study were to determine the functional outcome of mini-open carpal tunnel release procedure, to use the Boston Questionnaire to determine the functional outcome following mini open carpal tunnel release which includes pain, numbness, weakness and fine hand activities.

Methods: This descriptive cross-sectional was conducted in National After informed consent, the cases who meet the informed criteria were examined and relevant details were filled up in the proforma pre-operatively and two weeks post-operatively. Assessment of the patient's symptom severity and functional status was done with the Boston questionnaire.

Results: CTS was most common in the age group of 25-29 years (36.36%) and was predominant in housewives (18.20%). Mean symptom severity scores per person improved from 3.11 pre-operatively to 1.12 post-operatively. Mean functional status scores per person improved from 2.65 pre-operatively to 1.03 post-operatively. There was a statistically significant improvement in postoperative outcomes in our population.

Conclusions: The findings in this study indicate that mini-open carpal tunnel release has a good functional outcome.

Keywords: carpal tunnel syndrome; compression neuropathy; transverse carpal ligament.

INTRODUCTION

Carpal tunnel syndrome is the most common compression neuropathy in clinical practice.¹ It results from median nerve compression at wrist, which impedes median nerve perfusion producing numbness, tingling, and muscle weakness or atrophy.² It accounts for approximately 90% of all entrapment neuropathies and middle aged females are commonly affected.³

Reported risk factors for the development of CTS include age, smoking, obesity, rheumatoid arthritis, diabetes, lupus, hypothyroidism, and multiple sclerosis.⁴ Women, especially those taking birth control pills, going through menopause, or taking estrogen, have the highest risk of developing CTS. Working with vibrating tools or on an assembly line that requires prolonged or repetitive flexion of the wrist has been suggested as a risk factor, but scientific evidence is conflicting.

Hence, the objective of the study is to determine the functional outcome of mini-open carpal tunnel release procedure and to analyze pain, numbness, weakness and

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fine hand action following mini-open carpal tunnel release using the Boston Carpal Tunnel Questionnaire pre-operatively and post-operatively.

METHODS

This descriptive cross sectional study was conducted from July 2016 to December 2017 in National Trauma Center, Bir Hospital, Civil Hospital and Bharatpur Hospital. 33 cases of mini-open carpal tunnel release in carpal tunnel syndrome were taken.

Sample size calculation:

$$\begin{aligned}
 n &= \frac{Z^2 P(1 - P)}{d^2} \\
 &= \frac{(1.96)^2 \times 0.038 (1 - 0.038)}{(0.065)^2} \\
 &= \frac{3.8416 \times 0.036556}{0.004225} \\
 &= 33.24 \approx 33
 \end{aligned}$$

- Z = 1.96 for 95% confidence interval
- P = prevalence, taken here as 3.8% i.e. 0.0385,32
- d = desired precision (kept here as 0.065)

INCLUSION CRITERIA:

Criteria for diagnosis:

Paresthesia and pain in volar aspect of radial 3 ½ digits (thumb, index, long and radial half of ring fingers) and positive carpal tunnel compression test (Durkan test).

1. Diagnosed cases undergoing carpal tunnel release after failed conservative treatment

Criteria for failure of conservative treatment: Failure after two episodes of steroid injections.

2. Age 16 years and above
3. Both males and females

Exclusion Criteria:

1. History of cervical radiculopathy especially C6 or C7 nerve root involvement, brachial plexus lesions, thoracic outlet syndrome, pronator syndrome, cubital tunnel syndrome, ulnar tunnel syndrome, peripheral neuropathy
2. Diagnosed compartment syndrome involving the forearm or hand, pregnancy, post trauma, post burn contracture
3. Carpal Tunnel Syndrome due to diagnosed systemic illness like fibromyalgia, osteoarthritis, inflammatory arthropathy involving the small joints of the hand

With ethical clearance from Institutional Review Board (IRB) of National Academy of Medical Sciences, permission from Department of Orthopaedics Bir Hospital, Civil Hospital and Bharatpur Hospital and after obtaining the informed consent of the patient (Annex 1A, 1B), prospective case study was conducted.

All patients in the Inclusion Criteria were enrolled in this study.

Relevant history and examination findings were noted in a pre-designed performa: (Annex 2A, 2B)

- With ethical clearance from Institutional Review Board (IRB) of National Academy of Medical Science, permission from Department of Orthopaedics National Trauma Center, Bharatpur Hospital and Civil Hospital and after obtaining informed consent from the patient (Annex 1A, 1B), prospective case study was conducted.

- All the patients in the inclusion criteria were included in the study.
- Relevant history and examination findings were noted in a predesigned Performa (Annex 2A, 2B).
- Data from the patient performa including Serial number, Name, Age, Gender, Marital status, Religion, Occupation, eleven variables of symptom severity score pre and post-operatively respectively as well as eight variables from functional status score pre and post-operatively were entered in Microsoft Excel 2013 and were analyzed in International Business Machines SPSS (Statistical Package for the Social Sciences) version 23 for Macintosh software.
- After this, the data was analyzed for arithmetic mean, median, mode, range and standard deviation using appropriate tools.
- Age data was divided into age categories and analysis was done. In descriptive statistics, frequency and percentages was calculated.
- The mean Boston Questionnaire (BQ) Symptom Severity Score and Functional Status scores were calculated both pre- and post-operatively and the improvement in scores were observed.
- P-values were calculated using the paired samples test for SSS and FSS pre- and post-operatively respectively. Values less than 0.05 were considered statistically significant and values less than 0.005 were considered highly significant.

RESULTS

Table 1. Pre-operative and post-operative symptom severity scores.

	Pre-operative SSS				Post-operative SSS			
	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.
How severe is the hand or wrist pain that you have at night?	2	5	3.85	0.51	1	3	1.27	0.52
How often did hand or wrist pain wake you up during a typical night in the past two weeks?	2	4	3.15	0.62	1	3	1.18	0.47
Do you typically have pain in your hand or wrist during the daytime?	2	4	3.24	0.66	1	2	1.03	0.17
How often do you have hand or wrist pain during the daytime?	2	4	2.94	0.66	1	2	1.09	0.29
How long, on average, does an episode of pain last during the daytime?	2	3	2.52	0.51	1	2	1.06	0.24
Do you have numbness (loss of sensation) in your hand?	2	3	2.76	0.44	1	2	1.09	0.29
Do you have weakness in your hand or wrist?	1	4	2.21	0.86	1	2	1.06	0.24
Do you have tingling sensations in your hand?	3	5	3.58	0.56	1	2	1.27	0.45
How severe is numbness (loss of sensation) or tingling at night?	3	5	4.27	0.88	1	2	1.12	0.33
How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	2	4	3.21	0.65	1	2	1.03	0.17
Do you have difficulty with the grasping and use of small objects such as keys or pens?	2	3	2.52	0.51	1	2	1.09	0.29

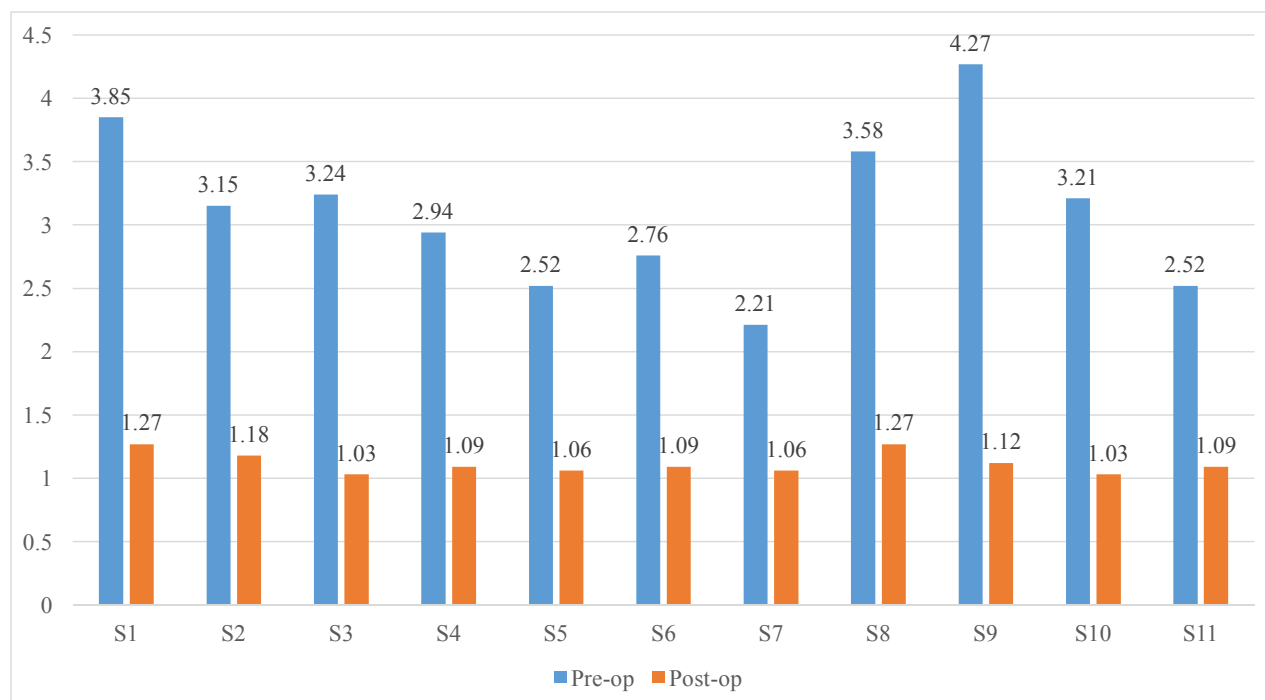
Table 2. Pre-operative and post-operative functional status scores

	Pre-operative SSS				Post-operative SSS			
	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.
Writing	2	4	2.91	0.522	1	1	1	0
Buttoning of clothes	1	4	2.15	0.712	1	1	1	0
Holding a book while reading	1	4	2.36	0.699	1	1	1	0
Gripping of a telephone handle	1	4	2.36	0.783	1	2	1.09	0.292
Opening of jars	1	4	2.91	1.1	1	1	1	0
Household chores	2	4	3.3	0.81	1	2	1.09	0.292
Carrying of grocery bags	2	4	3.39	0.747	1	2	1.03	0.174
Bathing and dressing	1	3	1.82	0.584	1	1	1	0

TABLE 3. DESCRIPTIVE STATISTICS OF THE SYMPTOM SEVERITY SCALE AND FUNCTIONAL STATUS SCALE PRE- AND POST-OPERATIVELY

	N	Minimum	Maximum	Mean
SSS preoperative	33	2.18	3.73	3.11
SSS postoperative	33	1.00	1.91	1.12
FSS preoperative	33	1.63	3.38	2.65
FSS postoperative	33	1.00	1.38	1.03

Mean symptom severity scores per person improved from 3.11 pre-operatively to 1.12 post-operatively. Mean functional status scores per person improved from 2.65 pre-operatively to 1.03 post-operative scores.

**Figure 1.** Bar diagram showing analysis of symptoms for each symptom severity score question.

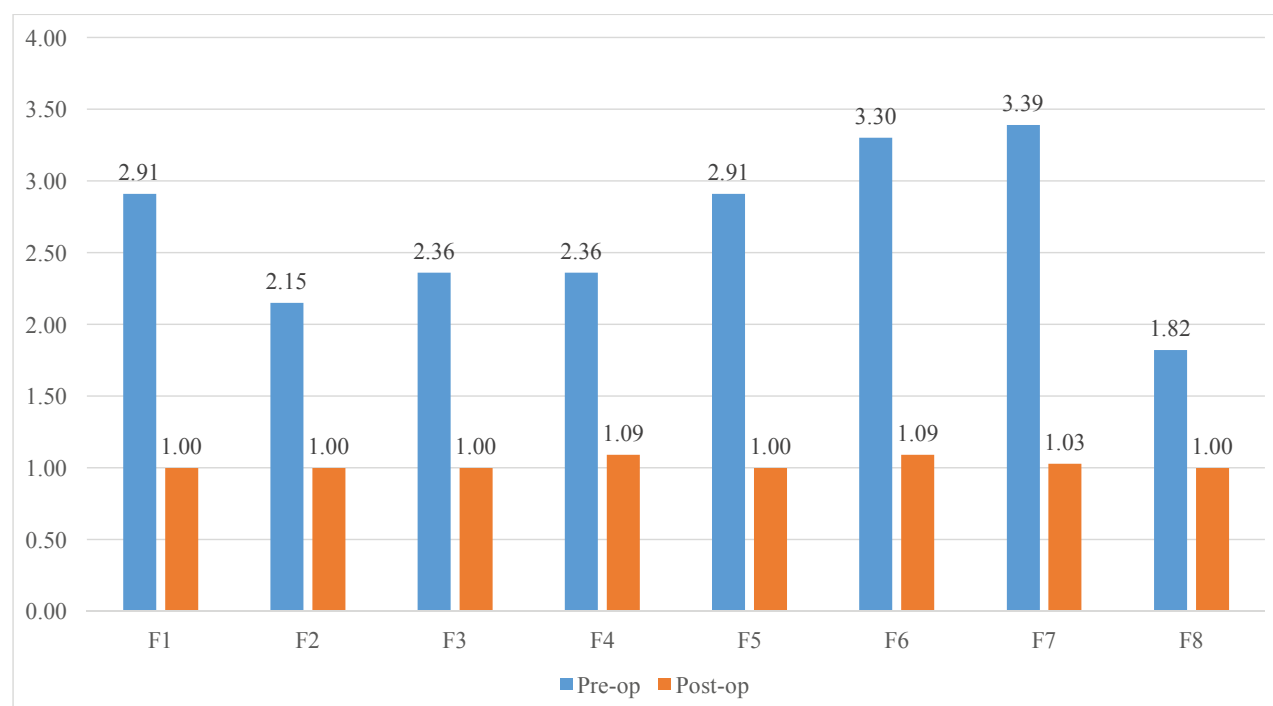


Figure 2. Bar diagram showing analysis of functional status score questions.

DISCUSSION

In the current study, the mean age was 29 years. In the study by Murthy et al the mean age was 62 years and in the study by Meirelles et al it was 57.^{5,6} The youngest person in my study was of 19 years and the oldest was of 38 years. In the study by Heybeli et. al.²¹ the mean age was 48 years (range 33-66 years). The age findings of my study refutes from the findings in other studies. My study shows that most Nepalese suffer from carpal tunnel syndrome in early age.

There were 97% females and 3% males in my study. There were forty females and four males in the study by Heybeli et al thereby 9% of the total cases were males and the rest 91% were females.⁷ In the study by Meirelles et al out of 53 cases, 52 were females and 1 was male.⁶ Hence, all of these studies demonstrate that carpal tunnel syndrome is more common amongst females and there is female predominance in my study too.

CTS was present more commonly in active blue-collar workers (working class people who perform manual labor) in my study. This

was similar to the findings in the study by Atroshi et.al.⁹ In the study done by Atroshi et. al., clinically and electro-physiologically confirmed CTS was present in 25 of 710 active blue-collar workers (prevalence, 3.5%), and in 12 of 712 active white-collar workers (prevalence, 1.7%) (95% CI for the difference, 0.2%-3.6%; $P = .03$). The higher prevalence among active blue-collar workers was significant even after adjusting for sex, age, and body mass index. The prevalence of confirmed CTS among working subjects who reported more than 1 hour/day use of excessive force with the hand during work and those reporting less frequent or no such use was 5.4% and 1.8%, respectively (95% CI for the difference, 1.4%- 6.8%; $P < .001$).

In this study, the pre-operative average SSS was 34.24 which decreased to 12.3 post-operatively. This suggests that the patients' symptoms resulting from carpal tunnel syndrome became better as a result of performing mini-open carpal tunnel release. Similarly, in the study done by Gowtham et. al.¹ done in 2014, the average symptom severity score (SSS) was 28.72 pre-operatively and 8.22 post-operatively. This also indicates

that the patients symptomatically improved after mini-open carpal tunnel release done in carpal tunnel syndrome.

Similarly, the mean SSS had decreased from 3.11 pre-operatively to 1.12 post-operatively in my study. This suggests that the patients' symptoms resulting from carpal tunnel syndrome became better as a result of performing mini-open carpal tunnel release. In the study by Murthy et al the post-operative average SSS was 12.93.5 In the study by Meirelles et al the mean SSS post-operatively was 1.41 ± 0.57 .6 The mean SSS post-operatively in the study by Padua et al done in 1999 was 2.4. 8 The studies from Meirelles, Murthy and Padua only have post-operative data and no pre-operative data hence their functional outcome cannot be properly assessed as in our study. The mean SSS had decreased from 3.4 preoperatively to 1.3 post-operatively in the study by Heybeli et. al.⁷ This is similar to the findings of my study.

In my study, the average FSS had decreased from 21.21 pre-operatively to 8.21 post-operatively. In the study by Gowtham et. al,¹ the average functional status score (FSS) was 24.24 pre-operatively whereas it was 5.12 post-operatively. In the study by Murthy et al post-operative average FSS was 9.37.5 However, the study by Murthy did not have pre-operative evaluation hence comparative analysis cannot be done between two findings.

Similarly, in my study, the mean FSS had decreased from 2.65 pre-operatively to 1.03 post-operatively. The mean FSS post-operatively in the study by Meirelles et al was 1.59 ± 0.93 .6 The mean post-operative FSS was 1.8 in the study by Padua et. al.⁸ This suggests that the patients in my study had good functional outcome after performing mini-open carpal tunnel release similar to the other studies mentioned above.

The studies by Murthy et al Meirelles and Padua have not included pre-operative average and mean SSS and FSS.^{5,6,8} This makes comparative analysis with these studies difficult.

The p value in this study was statistically significant <0.001 both for SSS and FSS. Meirelles et. al. had conducted a study in 2006 in which the p value was statistically significant i.e. it was <0.001 .6 Heybeli et. al. in 2002, found that the p-value was <0.001 .⁷ The functional outcome of mini-open carpal tunnel release was found to be statistically significant in my study similar to that of the studies done by Meirelles and Heybeli, showing that good outcome is there.^{6,7} However, the p value was not significant in the study by Murthy et. al. being 0.926 for SSS and 0.517 in FSS.5

In the study by Murthy et. al., one patient in the mini-incision cohort required revision surgery after 2 years, while no patient in the extended release cohort underwent revision.⁵ However, in our study as the follow up period was only two weeks, long term outcome and complications could not be assessed.

This study had some other pitfalls as well. Sample size was only 33, which is relatively small. There was no control group. Inter-observer variations were there.

CONCLUSION

Females were affected with carpal tunnel syndrome to a much greater extent than males. The most common age-group was 25-29 years. Housewives were mostly affected. This study shows that mean symptom severity scores per person improved from 3.11 pre-operatively to 1.12 post-operatively. Mean functional status scores per person improved from 2.65 pre-operatively to 1.03 post-operatively. Therefore, Mini-open carpal tunnel release has a good functional outcome.

CONFLICT OF INTEREST: None.

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