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## Original Article

# Outcome of Carpal Tunnel Decompression Using the Mini-Open Technique in a Tertiary Care Center

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***ABSTRACT***

***Introduction:*** *Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment syndrome. The high prevalence of CTS and its effect on quality of life makes it worthy of evaluation to find an effective method of treatment that would be cost-effective and satisfactory. Even though the mini-incision CT release has limited visualization, its result is promising. So, this study aimed to evaluate the outcome of the vertical mini-open technique for decompressing the carpal tunnel.* ***Methods & Materials:*** *This was a prospective observational study conducted in the Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh during the period from January 2020 to December 2021. In our study, we included 44 diagnosed cases of carpal tunnel syndrome who underwent carpal tunnel decompression using*

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*the mini-open technique.* ***Result:*** *The mean age was 45.6±8.5 years with a female predominance (81.8%). The mean duration of the first occurrence of symptom to surgery was 15.8±3.2 months. The mean duration of follow-up was 26.9±2.9 weeks. The mean length of scar at the last follow-up was 19.8±1.7mm. The mean preoperative resting VAS was 7.8±1.2 which significantly decreased to 2.1±1.1 (p <0.001). The mean preoperative BCTSQ symptom severity score was 38.9±2.3 which has decreased significantly to 12.1±2 (p <0.001).* ***Conclusion:*** *Carpal tunnel decompression using a mini-open technique gives significant symptom and functional improvement compared to preoperative status. It is a safe approach for patients with carpel tunnel syndrome.*

***Keywords:*** *Carpel tunnel syndrome, Carpal tunnel decompression, Mini-open technique, Outcome*

## INTRODUCTION

Carpal tunnel syndrome (CTS), which was first described in 1854 by Sir James Paget, is the most common peripheral nerve entrapment syndrome worldwide, accounting for 90% of all entrapment neuropathies[1-3]. The carpal tunnel (CT) is fibro-osseous and located in the volar portion of the wrist. It runs from the wrist flexion crease to the distal boundary of the thenar eminence, containing the median nerve and the tendons of the flexor digitorum superficialis, flexor digitorum profundus, and flexor pollicis longus[4].

The symptoms of CTS include tingling, discomfort, and numbness in the affected hand. When the median nerve is crushed or constricted while passing through the wrist, CTS results. Manual laborers are frequently affected by CTS, a musculoskeletal illness that is linked to work activity and is brought on by strain and repetitive action[5].

CTS is diagnosed by nocturnal numbness, numbness and tingling in the median nerve distribution, weakness and/or atrophy of the thenar muscles, positive Tinel's sign, painful Phalen's maneuver, and impaired opposition[6]. In nerve conduction studies (NCS), severe CTS has traditionally been described as a non-recordable distal sensory latency combined with increased distal motor latency[7]. Many factors can increase the risk of developing CTS, such as gender, obesity, advanced age, pregnancy, work activities requiring repetitive force and vibratory tools, and coexisting medical conditions like thyroid disorders, diabetes mellitus, and rheumatoid arthritis[8-11].

Research indicates that between 4% and 5% of persons globally have CTS, with older adults between the ages of 40 and 60 being the most susceptible[5,12]. In comparison to men, women experience CTS at a higher rate. According to Burton et al. (2014), the UK General Practice Research Database assessed the prevalence of CTS in males in 2000 at 88 per 100,000, but the incidence was 193 per 100,000 in females[13]. Finding an efficient treatment strategy that would be both affordable and satisfactory is important due to the high frequency of CTS and its impact on quality of life[2].

Non-surgical modalities are mostly preferred in mild to moderate stages. These include wrist splints or corticosteroid injections[4].

Currently, when conservative treatment has failed or symptoms are severe, surgery is recommended. The fundamental idea of CTS surgery is to expand the carpal tunnel's capacity to relieve pressure on the median nerve[14]. Ever since Dr. Phalen established surgery as a widely accepted treatment in 1950, numerous surgical techniques have been reported for the release of this tunnel[15]. Several unique methods and tools have been devised to improve the success rate of carpal tunnel surgery, including approaches for carpal tunnel release (CTR), which have been the subject of substantial research. The traditional surgical approach is a standard open CTR[2].

New surgical procedures are always being developed to achieve the best possible clinical outcomes with the least amount of incision and exposure. Similar trends have been observed in the treatment of CTS, with surgeons shifting toward shorter incision lengths and more conservative surgical techniques[7]. According to Sayegh and Strauch (2015), the transverse carpal ligament is separated in the mini-open CTR by a much smaller incision (1-3 cm)[16]. The mini-incision CT release has reduced vision, but it does not appear to have a higher risk of problems at this time[17].

So, the current study aimed to evaluate the outcome of the mini-open technique for decompressing the carpal tunnel in relieving symptoms in patients with severe CTS.

**METHODS & MATERIALS**

This was a prospective observational study conducted in the Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh during the period from January 2020 to December 2021. In our study, we included 44 diagnosed cases of carpal tunnel syndrome who underwent carpal tunnel decompression using the mini-open technique.

These are the following criteria to be eligible for enrollment as our study participants: a) Patients aged more than 18 years; b) Patients diagnosed with CTS confirmed by nerve conduction study (NCS); c) Patients with idiopathic CTS (not caused by acute trauma or any systemic disease); d) Patients who were suitable for a mini-open incision under regional anaesthesia; e) Patients who were willing to participate were included in the study And a) Patients who previously undergone carpal tunnel surgery; b) Patients with pregnancy; c) Patients with inflammatory arthropathy, deformities of the affected hand/wrist; d) Patients with concurrent presence of mono or poly neuropathies other than CTS or myopathies; e) Patients with any history of acute illness (e.g., renal or pancreatic diseases, ischemic heart

disease, asthma, COPD, etc.) were excluded from our study.

All patients (n=44) received a mini-open CTR done under regional anesthesia (Supraclavicular Brachial plexus block). All patients had received a single dose of Inj. Ceftriaxone 1 gram intravenously 30 minutes before surgery. Surgical incision with a skin pen was first done so that the longitudinal incision begins just distal to the distal wrist flexion crease and slightly ulnar to the midline of the wrist and extends distally approximately 2 cm in line with the ulnar side of the third web space. Exposure of the transverse carpal ligament (TCL) requires splitting of the parallel palmar fascia fibers and ulnar retraction of the hypothenar fat. Frequently, intrinsic muscles obscure the midline of the TCL and can be released from their origin and reflected away from the underlying TCL. After that, hemostasis of the remaining portions of the distal and proximal portions of the undivided TCL and antebrachial fascia was done. The distal 2.0 cm of the antebrachial fascia can then be safely divided with blunt-tipped Metzenbaum or Mayo scissors. After that, the tourniquet was deflated and Unipolar cautery was used for hemostasis. The incision was closed with interrupted 4-0 polypropylene suture and a pressure bandage was applied with casting incorporated into the dressing.

After surgery, patients were kept on observation for 4 hours and then discharged. Change the dressing on day 2 or 3. The next follow-up was given after 2 weeks. At this follow-up, the stitch was removed, and signs of infection were checked. The next follow-up was given at 12 weeks. Clinical and patient-reported outcomes were evaluated on an outpatient basis at 12 weeks and 6 months (24 weeks) post-intervention. Motor and sensory tests were performed. Postoperative complications were recorded. Each patient has filled up the Boston Carpal Tunnel Syndrome Questionnaire during each follow-up.

All data were recorded systematically in preformed data collection form. Quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Continuous variables were compared by student's t-test between two parameters. Qualitative variables were analyzed by the Chi-Square test. A p-value <0.05 was considered as significant. Statistical analysis was performed by using SPSS 25 (Statistical Package for Social Sciences) for Windows version 10. The study was approved by the Ethical Review Committee of the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR).

**RESULTS**

During this study, a total number of 44 patients with carpal tunnel syndrome who fulfilled the inclusion criteria were selected. In this study, the following results were obtained. **Table I** shows that the majority (40.9%) of our study

patients were aged 43-52 years old, followed by 29.5% and 22.7% of patients aged 33-42 & 53-62 years old respectively. The mean age was 45.6±8.5 years. The highest age was 62 years and the lowest age found was 23 years. The majority of our participants were female 36 (81.8%) compared to male was 8 (18.2%). The male-female ratio was 1:4.5 in our study. Most of the patients were housewives (63.6%), and 20.5% were service holders.

**Table – I: Distribution of Cases According to Age, Gender & Occupation (*n*=44)**

| Age (years) | Frequency | Percentage |
|---|---|---|
| 23-32 | 3 | 6.8 |
| 33-42 | 13 | 29.5 |
| 43-52 | 18 | 40.9 |
| 53-62 | 10 | 22.7 |
| Mean±SD | 45.6±8.5 | |
| Gender | | |
| Male | 8 | 18.2 |
| Female | 36 | 81.8 |
| Occupation | | |
| Housewife | 28 | 63.6 |
| Service holder | 9 | 20.5 |
| Laborer | 4 | 9.1 |
| Business | 3 | 6.8 |

The mean duration of first occurrence of symptoms to surgery was 15.8±3.2 months ranging from 11 months to 25 months. Most of the patients have suffered for 11 to 15 months (61.4%). The mean duration of follow-up was 26.9±2.9 weeks, ranging from 21 weeks to 34 weeks. Among the 44 cases, most of the cases were followed up for 26 to 30 weeks (47.7%). Sixteen (36.4%) cases and 7 (15.9%) cases were followed up for 21 to 25 weeks and 31 to 34 weeks respectively (**Table II**).

**Table – II: Distribution of Cases According to the Duration of the First Occurrence of Symptom to Surgery & Follow-up (*n*=44)**

| Duration of first occurrence of symptoms to surgery (Months) | Frequency | Percentage |
|---|---|---|
| 11-15 | 27 | 61.4 |
| 16-20 | 13 | 29.5 |
| 21-25 | 4 | 9.1 |
| Total | 44 | 100.0 |
| Mean±SD | 15.8±3.2 | |
| Duration of follow-up (weeks) | | |
| 21-25 | 16 | 36.4 |
| 26-30 | 21 | 47.7 |
| 31-34 | 7 | 15.9 |
| Total | 44 | 100.0 |
| Mean±SD | 26.9±2.9 | |

**Table III** shows that the mean length of the scar at the last follow-up was 19.8±1.7mm. Thirty-four (77.3%) patients had scar lengths of 17 mm to 20 mm and the remaining 10 (22.7%) patients had scar lengths of 21 to 24 mm.

**Table – III: Distribution of Cases According to Length of Scar at Last Follow-up (mm) (*n*=44)**

| Length of scar at last follow-up (mm) | Frequency | Percentage |
|---|---|---|
| 17-20 | 34 | 77.3 |
| 21-24 | 10 | 22.7 |
| Total | 44 | 100.0 |
| Mean±SD | | 19.8±1.7 |

**Table IV** shows that the mean preoperative resting VAS was 7.8±1.2 which decreased significantly to 4.9±1.1 after 6 weeks of surgery (*p*-value<0.001). After 12 weeks VAS further significantly decreased to 3±1 (*p*<0.001) and also at the last follow-up to 2.1±1.1 (*p* <0.001).

**Table IVI: Distribution of Cases According to Resting Pain According to Visual Analogue Scale (VAS) at Different Follow-ups (*n*=44)**

| VAS at different follow-up | Mean±SD | *p*-value |
|---|---|---|
| Preoperative VAS | 7.8±1.2 | |
| VAS at 6 weeks | 4.9±1.1 | <0.001 |
| VAS at 12 weeks | 3.0±1 | <0.001 |
| VAS at 24 weeks | 2.1±1.1 | <0.001 |

**Table V** shows that the mean preoperative BCTSQ (SSS) was 38.9±2.3 which has decreased significantly to 27.6±2.9 after 6 weeks of surgery (*p*-value<0.001). After 12 weeks BCTSQ symptom severity score further significantly decreased to 19±2.6 (*p*<0.001) and also at the last follow-up to 12.1±2 (*p*<0.001).

**Table – V: Distribution of Cases According to BCTSQ Symptom Severity Score (SSS) at Different Follow up (N=44)**

| BCTSQ (SSS) at Different Follow-up | Mean±SD | *p*-value |
|---|---|---|
| Preoperative BCTSQ (SSS) | 38.9±2.3 | |
| BCTSQ (SSS) at 6 weeks | 27.6±2.9 | <0.001 |
| BCTSQ (SSS) at 12 weeks | 19.0±2.6 | <0.001 |
| BCTSQ (SSS) at 24 weeks | 12.1±2 | <0.001 |

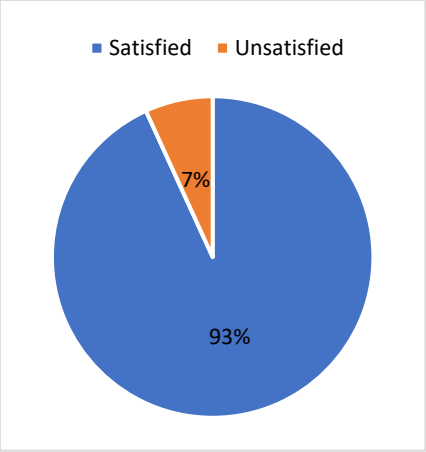


**Figure – 1: Patient Satisfaction Level at 24 Weeks of Follow-up (*n*=44)**

The pie chart shows that among 44 patients, 41 (93%) patients were satisfied with their symptoms and scars. Only 3 (7%) patients were dissatisfied with their symptoms or scars. Patient satisfaction level was assessed by asking

them about their satisfaction level (**Figure 1**).

**DISCUSSION**

This prospective observational study validated the benefits of mini-open CTR under regional anesthesia, in terms of clinical recovery and relief of symptoms within the planned follow-up period which was usually 24 weeks post-surgery. These improvements were of both statistical significance and clinical importance. The mean age was 45.6±8.5 years. Eighteen (40.9%) patient's ages were between 43 to 52 years. In a review article by ***Genova et al., (2020)*** at USA, found that the most susceptible population is elderly individuals aged between 40 and 60 years. This finding coincides with the result of the present study[5]. In the current study, most of our study patients were female (81.8%) compared to male (18.2%). ***Blumenthal et al., (2006)*** revealed that the incidence of CTS is higher for women aged between 45 and 54 years which is also a similar finding to the present study[18]. In this study, most of the patients were housewives (63.6%). ***Genova et al., (2020)*** found that CTS is a common problem among manual laborers[5].

The mean duration of first occurrence of symptoms to surgery was 15.8±3.2 months ranging from 11 months to 25 months. Most of the patients have suffered for 11 to 15 months (61.4%, n=27). In the study of van den ***Broeke et al., (2019)*** the mean duration of symptoms to surgery was 13.35 months which is similar to the present study[2].

The mean duration of follow-up was 26.9±2.9 weeks, ranging from 21 weeks to 34 weeks. Among the 44 cases, most of the cases were followed up for 26 to 30 weeks (47.7%, n=21). It is also evident from previous studies that, without similar follow-up durations, it is not possible to determine the outcome with certainty[7].

The mean length of scar at the last follow-up was 19.8±1.7mm. In the study of ***Khoshnevis et al., (2020)*** the mean scar length was 17±3.4 mm which is comparable to the present study[4]. The mean preoperative resting VAS was 7.8±1.2 which decreased significantly to 4.9±1.1 after 6 weeks of surgery ($p$-value<0.001). After 12 weeks it further significantly decreased to 3±1 (p<0.001) and also at the last follow-up to 2.1±1.1 ($p$<0.001). In the study of van den ***Broeke et al., (2019)***, the mean preoperative resting VAS was 3.8±3.1 which is less than the findings of the present study[2].

The mean preoperative BCTSQ (SSS) was 38.9±2.3 which has decreased significantly to 27.6±2.9 after 6 weeks of surgery ($p$-value<0.001). After 12 weeks it further significantly decreased to 19±2.6 (p<.05) and also at the last follow-up to 12.1±1 ($p$<0.001). As the symptoms decreased significantly, it signifies that the surgery was successful. This fact is also seen in the study of ***Anbarasan et al., (2017)*** where the evaluation of BCTSQ (SSS) score showed a marked reduction of mean preoperative BCTSQ (SSS) of 33.60 to

mean postoperative BCTSQ (SSS) of 15.25[15].

At the last follow-up, patients were asked about their satisfaction level either with symptoms or scars. Among them, 41 (93.2%) were satisfied with their symptom and scar. Only 3 patients were dissatisfied with either symptom or scar. In the study of ***Tarallo et al., (2014)*** only 2 patients were unsatisfied with their results. This result is similar to the present study [3]. Lee & Strickland (1998) found that the majority of the patients derived complete (72.6%) or near-complete (19.6%) symptom relief from the procedure. They concluded that this technique of carpal tunnel release combines the simplicity and safety of traditional open release and reduced tissue trauma & improved postoperative recovery of the endoscopic modality[19].

The first published literature found on mini-open technique for carpal tunnel release was the study of ***Abouzahr et al., (1995)***. They concluded that the procedure was simple, effective, inexpensive, and had a low complication rate[20]. ***Serra et al. (1997)*** presented their results on the short incision technique of carpal tunnel release and concluded that by using this mini approach it is possible to completely section the carpal ligament without damaging the median nerve and other carpal contents[21].

## Limitations of the study

Our study was a single-center study. We took a small sample size due to our short study period. Post-operative NCS was not done. After evaluating those patients, we did not follow up with them for the long term and did not know other possible interference that may happen in the long term with these patients.

## Conclusion and recommendations

In our study, we found that carpal tunnel decompression using the mini-open technique gives significant symptom relief and functional improvement compared to preoperative status. Our findings show that after decompression the mean VAS and BCTSQ symptom severity score significantly decreased at 6 months (24 weeks) post-intervention. So further study with a prospective and longitudinal study design including a larger sample size needs to be done to validate the findings of our study.

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**Conflict of Interest**

The authors declare no conflict of interest.

## Ethical approval

The study was approved by the Institutional Ethics Committee

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