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Assessment of pre-operative and post-operative functional outcome of Mini Open Carpal Tunnel Release in Carpal Tunnel Syndrome

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ABSTRACT

Introduction: Carpal tunnel syndrome (CTS) is the most common peripheral entrapment neuropathy, causing pain, functional impairment, and reduced quality of life. Mini-open carpal tunnel release (mOCTR) is a minimally invasive alternative to conventional surgery, offering quicker recovery and fewer complications.

Methods: A prospective pre-post study was conducted at KIST Medical College and Teaching Hospital, Nepal, from August 2024 to July 2025. Adult CTS patients undergoing mOCTR were included. Functional outcomes were assessed preoperatively and at 2 and 6 weeks postoperatively using the Boston Carpal Tunnel Questionnaire (BCTQ) for Symptom Severity Score (SSS) and Functional Status Score (FSS), and the Visual Analogue Scale (VAS) for pain. Data were analyzed in SPSS v26, with $p < 0.05$ considered significant.

Results: Twenty-seven patients were studied, mean age 50.1 years (SD ±9.7), with 24 (88.9%) females. Right-hand dominance was seen in 25 (92.6%), and right-hand involvement in 18 (66.7%). Housewives comprised 18 (66.7%) and desk job workers 5 (18.5%). Significant postoperative improvements were observed. Mean SSS reduced from 4.13 to 2.23 at 2 weeks and 1.43 at 6 weeks ($p < 0.01$). FSS declined from 3.93 to 2.31 and 1.39 at 2 and 6 weeks ($p < 0.01$). VAS pain scores decreased from 7.33 to 3.81 and 1.70 ($p < 0.01$). No major complications occurred; mild scar tenderness was seen in 2 (7.4%) patients, resolving spontaneously.

Conclusion: Mini-open carpal tunnel release is a safe and effective procedure with excellent functional outcome.

Keywords: Carpal tunnel syndrome, Functional outcome, Mini-open carpal tunnel release

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy, resulting from compression of median nerve within the carpal tunnel of the wrist [1,2]. It affects approximately 3–6% of adults, with higher prevalence in females and individuals performing repetitive hand activities such as house hold work, desk job or manual labour [1,2]. Patients typically present with numbness, tingling and pain along the median nerve distribution, often worsening at night or during activities that involve wrist flexion [3]. In chronic or severe cases, CTS may lead to weakness of the thenar muscles, impairing hand function and dexterity.

Conservative management remains the first-line treatment for mild to moderate CTS. Approaches include wrist splinting, corticosteroid injections, activity modification and physiotherapy, which can provide symptomatic relief and prevent disease progression [4]. However, when symptoms persist or functional impairment becomes significant, surgical intervention is warranted to decompress the median nerve and restore hand function. Traditional open carpal tunnel release (OCTR) has been the standard surgical procedure, providing reliable symptom relief. Despite its effectiveness, OCTR involves a relatively large incision which may result in scar tenderness, pillar pain and a longer recovery period [5].

Endoscopic carpal tunnel release (ECTR) emerged as a minimally invasive alternative, offering smaller incisions and faster functional recovery. Nevertheless, it carries a risk of nerve or vessel injury due to limited visualization during the procedure [6]. In response to these limitations, mini-open carpal tunnel release (mOCTR) was developed, combining the safety of direct visualization with the advantages of a smaller incision [7,8]. This technique aims to minimize soft tissue trauma, reduce postoperative pain and facilitate quicker return to daily activities while maintaining effectiveness in median nerve decompression.

This study aims to assess pre- and postoperative outcomes of patients undergoing mOCTR, focusing on its clinical effectiveness, safety and potential benefits. By evaluating patients' recovery, symptom relief and improvement in hand function, this study seeks to demonstrate how mOCTR can offer a safe and effective alternative to traditional open or endoscopic procedures. The findings will help surgeons make informed choices for optimal patient care.

METHODS

This was a prospective hospital-based pre-post interventional study conducted in the Department of Orthopedics at KIST Medical College and Teaching Hospital, Imadol, Lalitpur, Nepal. The study was carried out over a period of one year, from August 2024 to July 2025, following ethical clearance from the Institutional Review Committee of the institution (Ref no: 2081/82/01). Sampling was performed using a continuous convenience method. All eligible patients diagnosed with carpal tunnel syndrome (CTS) who underwent mini-open carpal

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tunnel release (mOCTR) were enrolled after providing informed written consent.

Patients included in the study were 18 years or older with a clinical diagnosis of CTS based on characteristic symptoms and physical findings (Tinel's sign, Phalen's test, Durkan's compression test), confirmed by nerve conduction studies [2,3]. For those with mild to moderate CTS, conservative treatment with non-steroidal anti-inflammatory drugs and wrist splinting was offered for at least two weeks before proceeding with surgery if symptoms persisted. Patients diagnosed with severe CTS were offered surgery upfront. Patients were excluded if they had clinical features suggestive of other neurological or musculoskeletal conditions such as cervical radiculopathy, brachial plexus lesions, thoracic outlet syndrome, or peripheral neuropathy. Additional exclusion criteria included pregnancy, history of trauma or burns to the affected limb, or the presence of contractures.

mOCTR was performed under local anesthesia without a tourniquet by the single hand surgeon of the institute. A 1.5–2 cm longitudinal palmar incision was made beginning at the intersection of Kaplan's cardinal line and the radial border of the third web space, extending proximally. The transverse carpal ligament was divided under direct vision according to the mini-open technique [9,10]. A light dressing was applied and changed every 4 days, with suture removal at 14 days. No splints were used, and patients were encouraged to begin gentle hand movements immediately postoperatively.

Clinical outcomes were assessed using the Boston Carpal Tunnel Questionnaire (BCTQ), which includes the Symptom Severity Scale (SSS) and Functional Status Scale (FSS), both validated for CTS and scored from 1 (mildest) to 5 (most severe) [11]. Pain was evaluated using the Visual Analogue Scale (VAS), graded from 0 (no pain) to 10 (worst imaginable pain) [12]. All scores were recorded preoperatively and reassessed at two and six weeks after surgery.

Data were collected using a structured proforma, analyzed with SPSS version 26, and continuous variables were expressed as mean ± SD. Preoperative and postoperative scores were compared using paired t-tests, with statistical significance set at $p < 0.05$.

RESULT

A total of 27 patients underwent mini-open carpal tunnel release in this study, with a mean age of 50.11 ± 9.69 years. The majority were female (n = 24, 88.89%), while males accounted for 11.11% (n = 3). Right-sided involvement was most common (n = 18, 66.67%), whereas left-sided (n = 7, 25.92%), and bilateral involvement (n = 2, 7.41%).

Most patients were right-hand dominant (n = 25, 92.59%). Regarding occupation, housewives represented the largest group (66.67%), while desk-based workers accounted for 18.52%, and doctors, drivers, carpenters and laborers each contributed 3.7% (Table 1).

Table 1: Distribution of patients by Occupation

Occupation	n (%)
Housewife	18 (66.67%)
Desk job	5 (18.52%)
Doctor	1 (3.70%)
Driver	1 (3.70%)
Carpenter	1 (3.70%)
Laborer	1 (3.70%)
Total	27(100%)

The pre-operative and post-operative outcomes after mini-open carpal tunnel release demonstrated significant improvement in symptom severity, functional status and pain. The mean SSS decreased from 4.13 ± 0.10 pre-operatively to 2.23 ± 0.19 at 2 weeks and 1.43 ± 0.16 at 6 weeks, with mean differences of 1.90 and 2.70, respectively ($P < 0.01$). Likewise, FSS scores declined from 3.93 ± 0.09 to 2.31 ± 0.15 at 2 weeks and 1.39 ± 0.15 at 6 weeks, corresponding to mean differences of 1.62 and 2.54, both highly significant ($P < 0.01$). Pain intensity assessed by VAS also improved, decreasing from 7.33 ± 0.78 pre-operatively to 3.81 ± 0.87 at 2 weeks and 1.70 ± 0.72 at 6 weeks, with mean differences of 3.52 ($P < 0.01$) and 5.63 ($P < 0.01$). Paired t-test analysis confirmed that these improvements were statistically significant, with greater benefit observed at 6 weeks, indicating early and progressive recovery following mini open carpal tunnel release (Table 2).

Table 2: Pre- and Post-Operative Mean Scores and Differences.

Test	Mean ± SD			Difference of Mean	
	Pre-Operative	Post-Operative 2 week	Post-Operative 6 weeks	Preop-postop 2 weeks	Preop-postop 6 weeks
Bostrom SSS	4.13 ± 0.10	2.23 ± 0.19	1.43 ± 0.16	1.9***	2.7***
FSS	3.93± 0.09	2.31 ± 0.15	1.39 ± 0.15	1.62***	2.54***
VAS	7.33± 0.78	3.81 ± 0.87	1.70 ± 0.72	3.52***	5.63***

*** P<0.01, **P<0.05

Postoperative complications were minimal with mild scar tenderness seen in 2 (7.4%) patients, resolving spontaneously.

Overall, these results indicate that mini-open carpal tunnel release provides rapid and significant relief of symptoms, improved hand function and decreased pain within the first 6 weeks after surgery, with consistent outcomes across age, sex, hand dominance and occupational groups.

DISCUSSION

In this study, mini-open carpal tunnel release (mOCTR) produced significant improvement in symptom severity, hand function, and pain within six weeks postoperatively. These findings are consistent with prior evidence showing that minimally invasive techniques are safe and effective alternatives to conventional open release [9,14].

The improvement in Symptom Severity Score (SSS) and Functional Status Score (FSS) aligns with previous studies demonstrating that mOCTR allows rapid functional recovery while minimizing soft tissue trauma [14,15]. Schwarz et al. reported that mini-open release achieves long-term symptom relief with high patient satisfaction and low complication rates [9]. Similarly, Malisorn showed that a mini-incision approach provides faster recovery and reduced scar discomfort compared to traditional open release [14]. Local evidence by Pradhan et al. also supports these findings in a Nepalese population, reporting favorable outcomes with mOCTR [15].

Pain reduction, as measured by VAS, was significant in our study, reflecting early mobilization and improved patient comfort. This is consistent with reports by Wongsiri et al., who noted reduced postoperative pain and quicker return to daily activities following mini-open release [8]. Compared with endoscopic carpal tunnel release, which offers faster recovery but carries risks of nerve injury and requires specialized equipment, mini-open release provides a practical and safe alternative [6,18]. Chang et al. also reported similar clinical outcomes between endoscopic and mini-open techniques, emphasizing the safety and ease of the mini-open approach [13]. Lalonde highlighted the efficiency and safety of minimally invasive techniques under local anesthesia, which is particularly useful in resource-limited settings [18].

Importantly, outcomes in our study were consistent across age, sex, hand dominance, and occupation. Housewives comprised the majority of our cohort, consistent with prior epidemiological studies showing higher CTS prevalence among females and individuals performing repetitive hand activities [2,3,15]. This demonstrates that mOCTR is broadly applicable across patient demographics and occupational groups.

Prior studies have demonstrated low recurrence rates after mini-open release, comparable to open and endoscopic approaches [16,17]. In this study, the short follow-up period of six weeks limits assessment of long-term outcomes, including recurrence and functional durability. Larger, multicenter studies with extended follow-up are warranted to validate these findings in the Nepalese context.

Limitations: This study has some limitations. The sample size was small and being a single-center study, the results may not be generalizable. The follow-up period was short, limiting assessment of long-term recovery and complications. Lack of a control group and reliance on patient-reported outcomes may introduce bias. Furthermore, the use of convenience sampling may have introduced selection bias, affecting the applicability of the findings.

CONCLUSION

mOCTR is a safe, effective, and minimally invasive option for CTS, providing rapid symptom relief and functional recovery while minimizing complications.

DECLERATION

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Conflict of Interest

None

Ethical Considerations

This research was approved by IRC of KIST Medical College and Teaching Hospital with the reference number of 2081/82/01.

Consent

Informed written consent was obtained from the all the eligible participants.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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The authors received no external fund for this study.

Author's Contribution

JLS reviewed the literature, conceptualized, designed the research and wrote the first draft of manuscript; AB and PB did data collection, ShS did the data analysis and wrote the results, BM drafted and edited the manuscript; SS supervised and reviewed the manuscript. All authors reviewed the manuscript and approved the final version of the manuscript. All authors agreed to be accountable for all aspects of the research work.

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