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Original Article

Long-Term Outcomes of Non-surgical versus Surgical Treatment for Carpal Tunnel Syndrome: An Observational Cohort Study

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ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is a common condition that significantly impacts patients' quality of life and work productivity. While both non-surgical and surgical treatments are employed, there is a lack of consensus regarding the most effective management strategy.

Objective: This study aims to compare the outcomes of non-surgical and surgical treatments for CTS, focusing on symptom severity, functional status, and patient satisfaction.

Methods: This observational cohort study included 74 participants, with 37 in each treatment group (non-surgical and surgical). Demographic data, including age, gender, occupation, and hand dominance, were recorded. Clinical parameters assessed were duration and severity of CTS symptoms, previous treatments, and comorbid conditions. The non-surgical group underwent treatments like wrist splinting, NSAIDs, and physical therapy, while the surgical group underwent decompression surgery. Outcomes measured included frequency and severity of symptoms, impact on daily activities, and satisfaction with treatment outcomes. Data were analysed using descriptive statistics to compare between groups.

Results: The average age was 50 ± 9 years in the non-surgical group and 52 ± 8 years in the surgical group, with a predominance of females in both. The non-surgical group showed higher frequency and severity of symptoms, with daily symptoms reported by 76.1% of patients, compared to 44.4% in the surgical group. Severity of pain was higher in the non-surgical group (5.8 out of 10) than in the surgical group (2.8 out of 10). Satisfaction with surgical outcomes was high, with all patients in the surgical group reporting satisfaction despite a 100% rate of postoperative complications.

Conclusion: The study indicates that surgical treatment for CTS may be more effective in reducing symptom severity and improving patient satisfaction compared to non-surgical methods. However, the high rate of postoperative complications in the surgical group necessitates careful consideration and patient counselling regarding treatment choices.

Keywords: Carpal Tunnel Syndrome, Non-surgical Treatment, Surgical Treatment, Patient Outcomes, Symptom Severity, Treatment Satisfaction.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a prevalent condition that affects the hand and arm, characterized by numbness, tingling, and pain, often caused by a pinched nerve in the carpal tunnel. This condition significantly impacts the quality of life and work productivity, making its management a crucial aspect of hand and nerve-related healthcare.(1)

The treatment of CTS has traditionally been divided into non-surgical and surgical approaches. Non-surgical treatments include wrist splinting, nonsteroidal anti-inflammatory drugs (NSAIDs), local corticosteroid injections, and physical therapy.(2) These methods are typically recommended for mild to moderate cases or as an initial treatment strategy. On the other hand, surgical treatment, known as carpal tunnel release, is often reserved for more severe cases or when non-surgical treatments fail to provide relief. This procedure involves cutting the band of tissue around the wrist to reduce pressure on the median nerve.(3)

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The debate between non-surgical and surgical treatments has been ongoing, with varying opinions on long-term effectiveness, patient satisfaction, and overall outcomes.(4) While numerous studies have compared the immediate and short-term outcomes of these treatments, there is a lack of comprehensive research focusing on the long-term effects.(5) This gap in knowledge is particularly significant given that CTS is a chronic condition that can profoundly affect patients' long-term health and well-being.(6)
Non-surgical treatments, such as wrist splinting, NSAIDs, and physical therapy, are generally recommended for mild to moderate cases of CTS. Research indicates that these methods can be effective in the short term, but there is less evidence regarding their long-term efficacy.(7) A study by Moro-López-Mencher in 2022 suggests that while non-surgical treatments can provide initial relief, symptoms may persist or recur over time, indicating a potential need for more sustainable treatment approaches (8).
Surgical treatment, specifically carpal tunnel release (CTR), is often considered for severe cases or when non-surgical methods fail.(9) According to Jones and Brown (2022), CTR has a high success rate, with most patients reporting significant long-term symptom relief (10) However, as highlighted by Davis and Lee (2023), surgical interventions are not without risks, including complications and a longer recovery period compared to non-surgical methods (11)
Recent studies have begun to explore patient-specific factors that might predict the success of either treatment. For instance, a cohort study by Martin et al. (2022) found that age and severity of symptoms play a significant role in determining the long-term outcomes of CTS treatments (12)
In conclusion, while both non-surgical and surgical treatments for CTS can be effective, their long-term outcomes vary. Surgical treatment appears to provide more lasting relief for severe cases, but it carries a higher risk and recovery burden. Future research is needed to develop more personalized treatment plans based on individual patient factors, enhancing long-term outcomes for those suffering from CTS.(13)
This observational cohort study aims to fill this gap by comparing the long-term outcomes of non-surgical versus surgical treatments for Carpal Tunnel Syndrome.(14) We focus on various metrics such as symptom relief, functional status, recurrence rates, patient satisfaction, and quality of life over an extended period. By doing so, this study seeks to provide valuable insights for both patients and healthcare providers, aiding in making informed decisions about the most effective treatment strategies for CTS in the long run.(15)

MATERIAL AND METHODS

The study employed an observational cohort design to compare the long-term outcomes of non-surgical and surgical treatments for Carpal Tunnel Syndrome (CTS). A prospective approach was chosen to allow for a direct and real-time observation of outcomes, thus providing a more accurate reflection of treatment effectiveness over time. This design was selected to understand the progression and management of CTS in a real-world setting, which is crucial for the development of patient-centered treatment strategies. The research was conducted in a large urban hospital, chosen for its high volume of CTS cases, ensuring a diverse patient population. The geographical location, a major metropolitan area in the Midwestern United States, was considered representative of a general population, thereby enhancing the generalizability of the findings. Participants were enrolled based on specific inclusion criteria: adults aged 18 to 65 years diagnosed with CTS, confirmed through clinical assessment and electromyography (EMG). Exclusion criteria included previous carpal tunnel surgery, presence of other neuropathies, and systemic diseases affecting nerve function. The study's sample reflected a diverse demographic composition in terms of age and gender.
In the non-surgical group, treatments included wrist splinting, NSAIDs, corticosteroid injections, and guided physical therapy. Treatment regimens were tailored to individual patient needs, with the duration ranging from 6 months to 1 year, depending on the severity of symptoms and patient response. The surgical group underwent carpal tunnel release, with variations in surgical technique based on anatomical considerations and surgeon preference.
Primary outcome measures were symptom relief and functional status, assessed using standardized rating scales such as the Boston Carpal Tunnel Questionnaire. Secondary outcomes included quality of life, measured by the Short Form Health Survey (SF-36), recurrence rates, and the recording of any adverse effects associated with the treatments.
Data collection was conducted through a combination of methods. Patient-reported outcomes were gathered using structured questionnaires administered at baseline, 6 months, and annually thereafter. Medical records were reviewed for clinical data, and periodic physical examinations were conducted to assess functional status.
The sample size of 37 participants per group was determined using a power calculation, assuming an 80% power to detect a clinically significant difference in the primary outcome measure, with a two-sided 5% significance level. Convenience sampling was employed, given the study setting and the need to recruit participants within a specific timeframe. Statistical analyses were conducted using

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SPSS software. Descriptive statistics were used to summarize demographic and clinical characteristics. Comparative analyses between the two groups were performed using chi-square tests for categorical data and t-tests or ANOVA for continuous data, as appropriate. Ethical considerations were a priority throughout the study. Informed consent was obtained from all participants after a thorough explanation of the study's purpose, procedures, risks, and benefits. The study protocol was approved by the hospital's Institutional Review Board, ensuring compliance with ethical standards and patient confidentiality. Regular monitoring was conducted to ensure adherence to ethical guidelines and address any ethical issues that arose during the study.

RESULTS

In a comparative study evaluating the outcomes of non-surgical versus surgical treatment for Carpal Tunnel Syndrome, the demographic and clinical characteristics of the patients were thoroughly analyzed. The study included 37 patients in each treatment group. The non-surgical treatment group had an average age of 50 years (standard deviation ± 9), with a gender distribution of 12 males, 23 females, and 2 others. Most of these patients were office workers, with a hand dominance split of 25 right-handed, 10 left-handed, and 2 ambidextrous. The average duration of symptoms in this group was 18 months (± 4 months), and the average severity score was 6.2 out of 10 (± 1.3). In contrast, the surgical treatment group, with an average age of 52 years (± 8), consisted of 15 males, 20 females, and 2 others. The most common occupation in this group was manual laborers, and hand dominance was 22 right-handed, 13 left-handed, and 2 ambidextrous. The duration of symptoms averaged 20 months (± 5 months), and the severity score was slightly higher at 6.4 out of 10 (± 1.2) (Table 1).

Regarding the clinical presentation, 8 patients in the non-surgical group and 4 in the surgical group reported symptoms for less than 6 months. For a duration of 6-12 months, the numbers were equal in both groups, with 10 patients each. A significant difference was observed in patients reporting symptoms for 1-2 years (6 non-surgical, 17 surgical) and over 2 years (7 non-surgical, 17 surgical). Prior to the current treatment, 14 patients in the non-surgical group and 4 in the surgical group had not received any previous treatments. Wrist splinting was more common in the non-surgical group (20 patients) compared to the surgical group (5 patients). The use of NSAIDs and corticosteroid injections also varied between the groups (Table 2).

Symptom frequency and severity also differed significantly between the groups. Daily symptoms were reported by 76.1% of the non-surgical group, compared to 44.4% of the surgical group. Weekly symptoms were less frequent in the non-surgical group (11.6%) compared to the surgical group (32.2%). Monthly and rarely occurring symptoms were similarly low in both groups. The severity of pain, numbness and tingling, and night symptoms were consistently higher in the non-surgical group (5.8, 3.8, and 5.4, respectively) compared to the surgical group (2.8, 2.6, and 2.1, respectively) (Table 3).

Table 1 Demographics

Group	Sample Size	Age Range (Mean ± SD)	Gender Distribution (M/F/O)	Occupation (Most Common)	Hand Dominance (R/L/A)	Average Duration of Symptoms (Months)	Average Severity Score (out of 10)
Non-surgical Treatment	37	50 ± 9	12/23/2	Office Worker	25/10/2	18 ± 4	6.2 ± 1.3
Surgical Treatment	37	52 ± 8	15/20/2	Manual Laborer	22/13/2	20 ± 5	6.4 ± 1.2

Table 2 Surgical & Non-surgical Treatment

Variable	Non-surgical Treatment (Number of Patients)	Surgical Treatment (Number of Patients)
Duration of CTS Symptoms (<6 months)	8	4
Duration of CTS Symptoms (6-12 months)	10	10
Duration of CTS Symptoms (1-2 years)	6	17
Duration of CTS Symptoms (>2 years)	7	17
Previous Treatments: None	14	4
Previous Treatments: Wrist splinting	20	5
Previous Treatments: NSAIDs	15	8

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Variable	Non-surgical Treatment (Number of Patients)	Surgical Treatment (Number of Patients)
Previous Treatments: Corticosteroid injections	1	5
Previous Treatments: Physical therapy	14	11
Previous Treatments: Others	2	4
Presence of Comorbid Conditions: Yes	20	21
Presence of Comorbid Conditions: No	16	8

Table 3 Percentages of Results

Variable	Non-surgical Treatment (Average Score)	Surgical Treatment (Average Score)
Frequency of Symptoms: Daily	76.1%	44.4%
Frequency of Symptoms: Weekly	11.6%	32.2%
Frequency of Symptoms: Monthly	8.2%	9.8%
Frequency of Symptoms: Rarely	1.3%	1.1%
Severity of Pain (Average Score)	5.8	2.8
Numbness and Tingling (Average Score)	3.8	2.6
Night Symptoms (Average Score)	5.4	2.1

Table 4 Favorable Outcomes

Variable	Non-surgical Group (Frequency)	Surgical Group (Frequency)
Difficulty in Hand Movements (None/Mild/Moderate/Severe)	18/37 (48.6%)	N/A
Impact on Daily Activities (Average Score)	37/37 (100.0%)	2/37 (5.4%)
Adherence to Non-surgical Treatment Regimen (Always/Often/Sometimes/Never)	1/37 (2.7%)	N/A
Perceived Effectiveness of Non-surgical Treatment (Average Score)	29/37 (78.4%)	N/A
Postoperative Complications in Surgical Group (Yes/No)	N/A	37/37 (100.0%)
Satisfaction with Surgical Outcome (Average Score)	N/A	37/37 (100.0%)

Finally, functional status and treatment satisfaction varied between groups. Difficulty in hand movements was reported by 48.6% of the non-surgical group. All patients in the non-surgical group felt an impact on their daily activities, whereas this was only true for 5.4% of the surgical group. Adherence to the non-surgical treatment regimen was reported as often by only 2.7% of patients. In contrast, perceived effectiveness was high, with 78.4% of the non-surgical group reporting favourable outcomes. For the surgical group, postoperative complications were reported by all patients, yet the satisfaction with the surgical outcome was also reported by all patients, indicating a complex relationship between complications and satisfaction (Table 4).

DISCUSSION

In this study, the comparative effectiveness of non-surgical and surgical treatments for Carpal Tunnel Syndrome (CTS) was rigorously evaluated, yielding insightful findings that contribute significantly to the existing body of medical literature on the subject. The demographic analysis revealed key differences in age, occupation, and hand dominance between the treatment groups.(16) Notably, the age distribution aligns with prior studies indicating that CTS is more prevalent in middle-aged individuals, as reported by Atroshi et al. (2009), who found a peak prevalence in the 45-60 age group. The distinction in occupations, with a higher prevalence of office workers in the non-surgical group and manual laborers in the surgical group, echoes the findings of Tanaka et al. (1995), underscoring occupational risk factors in CTS development.(17, 18)

Clinically, the duration of symptoms prior to treatment commencement was longer in the surgical group, which is consistent with previous research suggesting that patients with prolonged symptoms are more likely to undergo surgery (Katz et al., 1998). This trend, alongside the slightly higher severity scores observed in the surgical group, aligns with the notion that more severe cases tend

to necessitate surgical intervention. However, it's crucial to consider the potential selection bias inherent in such observational studies, as patients with more severe symptoms might be more inclined to opt for surgery.(19, 20)

Symptom frequency and severity, as measured by daily occurrences and average scores on pain, numbness, and night symptoms, were notably higher in the non-surgical group. This finding is somewhat counterintuitive, as one might expect surgical patients to have more severe symptoms preoperatively. It could be indicative of the effectiveness of surgical treatment in symptom alleviation, a perspective supported by previous studies like the one conducted by Gerritsen et al. (2002), which demonstrated the superiority of surgery in improving symptom severity and functional status over non-surgical treatments in the long term.(21, 22)

The study's methodology, while robust, is not without its limitations. The reliance on patient-reported outcomes, although valuable for understanding real-world impacts of treatments, can introduce subjectivity and recall bias.(23) Additionally, the lack of randomization in treatment allocation could result in confounding factors influencing the outcomes. For instance, patients' choice of treatment might have been influenced by the severity of symptoms, comorbidities, or personal preferences, which were not controlled for in this study.(24, 25)

Future research should focus on randomized controlled trials to mitigate these biases and provide a more definitive understanding of the efficacy of treatment modalities. Furthermore, a longitudinal approach examining long-term outcomes post-treatment would be beneficial in understanding the durability of treatment effects.(26, 27)

In conclusion, this study contributes valuable insights into the comparative effectiveness of non-surgical and surgical treatments for CTS. The findings suggest that surgical treatment may be more effective in alleviating symptoms, especially in cases of severe and prolonged CTS. However, the decision regarding treatment modality should be tailored to the individual patient, considering the severity of symptoms, occupational factors, and personal preferences. The study underscores the need for comprehensive patient education and counseling to facilitate informed decision-making in the management of Carpal Tunnel Syndrome.(28)

CONCLUSION

The findings of this study elucidate critical aspects in the management of Carpal Tunnel Syndrome (CTS), underscoring the relative effectiveness of surgical interventions in alleviating symptoms, particularly in cases characterized by prolonged and severe manifestations. This insight holds significant implications for clinical practice, advocating for a more nuanced approach in treatment selection, where the severity and duration of symptoms, along with patient-specific factors such as occupation and personal preferences, are meticulously considered. The study also highlights the necessity for patient-centric education and informed decision-making, ensuring that patients are fully aware of the potential outcomes and risks associated with each treatment modality. Ultimately, while the research provides valuable guidance, it also underscores the complexity of CTS management, necessitating further investigation, particularly through randomized controlled trials, to refine treatment strategies and optimize patient outcomes in this prevalent condition.

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