Evaluating Post-Surgery Nerve Gliding Exercise among Patients with Carpal Tunnel Syndrome for Hand Function and Symptoms Severity

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Abstract

The median nerve compression that causes carpal tunnel syndrome (CTS) is a common cause of pain, discomfort, and impaired function; nerve gliding exercises help alleviate these symptoms and restore normal function. Aim: This study aimed to evaluate the post-surgery nerve gliding exercise among patients with carpal tunnel syndrome for hand function and symptoms severity. Design: The current study fulfilled its objectives by using a quasi-experimental research design. Setting: A neurosurgery unit at Minia University Hospital was the setting for the current study. Sample: Sixty adult patients diagnosed with CTS were included in the convenience non-probability sample. Tools: A Structured Interview questionnaire, Boston Carpal Tunnel Questionnaire (BCTQ), and Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire. Results: Six weeks after surgery, the study group showed statistically significant improvement in functional status and intensity of symptoms compared to the control group, with mean scores33.3 ± 7.5 & 71.9 ± 11.7 respectively at p- value ≤ 0.001. Conclusion: The results show that nerve gliding exercises are more helpful for post-operative CTS patients within the context of alleviating symptoms, increasing hand function, and reducing functional impairment in activity daily living (ADLs). Recommendations: Applying nerve gliding exercises for 6 weeks postoperatively should be mandated in order to alleviate patients' suffering with CTS.

Keywords: Carpal Tunnel Syndrome, Functional status, Symptoms severity, nerve gliding exercises.

Introduction

Inflammation of the tendons and nerves within the carpal makes the median nerve get compressed, which in turn causes paraesthesia in the hands and arms, as well as reduced function of the surrounding muscles. This condition is known as carpal tunnel syndrome (CTS) **(IONICĂ et al., 2024)**.

The flexor tendons of the hand can be affected by stenosing tenosynovitis, which is known as trigger finger (TF). One telltale sign is when extended from a flexed position, one or more fingers click and lock **(Aziz-Saba, 2021)**.

Compression of the median nerve typically manifests as acro paraesthesia affecting the lateral portion of the fourth finger, the first three fingers, and the middle finger. Nighttime paraesthesia, which is relieved by bending the fingers (the flick sign), and decreased strength and dexterity in the hands are other symptoms. Among females, CTS is ten times more common than in males, and its incidence ranges from one to three per thousand per year **(Farioli et al., 2018).**

The hallmarks of CTS are sensory and motor symptoms, including paresthesia, pain, and numbness that extend from the wrist to the first three fingers. When CTS gets worse, daily living activities, mental health, social interaction, and quality of life are all negatively impacted by muscular atrophy, decreased hand strength, and impaired hand dexterity **(Zaheer etal.,2023)**.

A higher prevalence of CTS is seen in males between the ages of 75 and 84 and in females between the ages of 45 and 54, according to epidemiological data. There is a significant difference in the reported frequency across different regions; for example, it occurs between 7% and 16% in the UK, but only about 5% in the US. Treatment options for CTS that do not involve surgery tend to be more conservative and include measures such as bracing or immobilization of the wrist, injections of local corticosteroids and physical therapy to avoid further aggravating symptoms **(Abid et al., 2024).**

Among the conservative treatments, nerve gliding exercises can relieve strain on the median nerve as it passes through the carpal tunnel, which improves blood flow inside the

nerve, lessens the effects of ischemia, and makes the surrounding tissues flexible, all of which reduces the likelihood of recurrent nerve entrapment and the symptoms it triggers **(Ceylan et al., 2023) & (Sheereen et al., 2022).**

Gliding exercises tendon were practiced for seven seconds in each of 5 possible positions: straight, hook, fist, tabletop, and straight fist. Every exercise was done three times a day for six weeks, with five repetitions of each. reduced symptoms while demonstrating beneficial impacts on functional capacity. Careful application of physiotherapy techniques alleviates symptoms of CTS **(Zaralieva et al., 2020).**

The role of nursing is crucial when it comes to managing and preventing CTS. Nurses can help improve outcomes for patients with CTS by identifying at-risk patients, educating patients about ways to prevent the illness, and collaborating with other medical experts to create treatment regimens. Nurses are pivotal in delivering therapies that alleviate CTS symptoms and enhance functional status. The nurse should advise the patients to perform hand exercises that may alleviate CTS symptoms and to provide light heat to the hands prior to exercising **(Asal etal., 2024).**

Significance of the study

The most prevalent mononeuropathy in the upper limbs is CTS, which is already regarded as an epidemic. **(Łach, etal., 2024).** Ninety percent of all peripheral neuropathies are caused by CTS, that affects 4–5% of individuals globally, 50 per 1000 in wealthy nations, 12.1% in East Africa, and 29.2% in Ethiopia **(Yesuf, etal., 2023).** In Egypt, two population-based studies in the Assiut and Qena Governorates found that it was 1.7% and 3.1%, respectively **(Elsharkawy, etal., 2023).**

Adults between the ages of 40 and 60 are the most vulnerable group of CTS occurrence, the prevalence of CTS in this group is thought to vary between 7% to 16% **(Khired, etal.,2024).** Syndrome of carpal tunnel is regarded as the primary cause of sick leave and work- related disability.Its temporary or permanent disability rates are rising that placing a heavy financial strain on families and society as a whole **(Zhou etal., 2023) & (Rotaru etal., 2024).**

One conservative therapy approach that is anticipated to hasten the alleviation of CTS symptoms in order to enhance functionality is nerve-gliding exercises (**Salsabila etal., 2024**). So that this study was conducted to explore the effect of post-surgery nerve gliding exercise among patients with CTS on hand function and symptom severity.

The researchers pointed out that no previous research has been done in this specific they believe that if nerve gliding exercise done correctly for patients with CTS postoperatively, this kind of intervention can have a substantial positive impact on hand function and CTS symptom severity as well as patient outcomes.

Aim of the study

Evaluating Post-Surgery Nerve Gliding Exercise among Patients with Carpal Tunnel Syndrome for Hand Function and Symptoms Severity

Research hypotheses

H1: Patients undergoing nerve gliding exercises will have a marked enhancement in hand function relative to the control group.

H2: Patients doing nerve gliding exercises will experience a considerably reduced severity of symptoms compared to the control group.

Operational definitions

- **Nerve gliding exercises** involve the implementation of tendon and nerve mobilization techniques. This approach reduces adhesion formation, improves nerve mobility, and facilitates healing, resulting in enhanced grip strength and dexterity.
- **Hand function** refers to a patient's capacity to perform routine everyday activities required for fulfilling basic needs, maintaining typical roles, and safeguarding health and well-being. Functional status may range from optimal capacity for daily tasks to profound

disability. Standardized functional assessments, including the DASH

- **Symptoms severity** pertains to the intensity of a series of complaints connected with the patient could feel tingling, weakness, and numbness in their hands and wrists as a result of compression of the median nerve at the wrist. The Boston Carpal Tunnel Questionnaire (BCTQ) and other validated instruments were used for these measurements.

Patients and Methods

Research Design:

A quasi-experimental research design was utilized to achieve the objectives of this study. The basic relationship between independent and dependent variables is explored via quasi-experimental research designs. One may expect the dependent variable to undergo some kind of change or variation as a result of the independent variable **(Rogers & Révész, 2019).** Experimental and quasi-experimental approaches evaluate the program or policy in question for its effectiveness in reaching its goals by treating it as an "intervention" that includes all of its constituent parts **(White & Sabarwal, 2014)**.

Research setting:

The current study was conducted at the neurosurgery inpatient unit which is situated on the second floor and has two rooms (each room contains four beds), as well as outpatient clinics that is contained two rooms for patients' examination and follow-up that is located on the ground floor at main Minia University Hospital in Egypt.

Sample size

A convenience non-probability sampling method was employed in our study. Using the formula

$$n = 2\left[\frac{(Z_{\alpha/2} + Z_{\beta}) * \sigma}{\mu_1 - \mu_2}\right]^2$$ **Dawson and Trapp (2004**).

Where n = sample size

Zα/2 = 1.96 (The critical value that divides the central 95% of the Z distribution from the 5% in the tail)

Zβ = 0.84 (The critical value that separates the lower 20% of the Z distribution from the upper 80%) σ = the estimate of the standard deviation = 10.7 ng/mL **(Romano et al., 2015)**

So, by calculation, the total sample size was equal to sixty patients (Study group 30 patients + 30 patients for control group = 60patients).

Inclusion criteria:

• Adult patients (ages 18-65 years) who have undergone carpal tunnel release surgery for CTS on at least one hand.

• Presence of enduring hand symptoms (pain, numbness, tingling, or weakness).

• Willingness to participate and adhere to the study protocol.

Exclusion criteria:

•Patients have a history of further upper extremity nerve compression symptoms. •Individuals with pre-existing illnesses that impair hand function (e.g., rheumatoid arthritis, neurological problems).

• Patients unable to execute the suggested exercises due to physical constraints.

Data Collection tools

The researchers executed three tools for data collecting.

Tool I: Structured interview questionnaire. It was designed by the researcher following a comprehensive literature assessment. It encompassed two primary sections :

Section one: The socio-demographic information of the patient, encompassing age, marital status, education, residence, and occupation.

Section two: The medical-surgical information included data such as medical history, surgical history, name of the

operation, length of the condition, and prior CTS surgery.

Tool II: Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ)

This questionnaire was utilized to evaluate the severity of CTS symptoms and the functional state of the affected hand. It was derived **from Levine et al, (1993).** It consisted of two subscales, including:

Initial subscale (Severity of Symptoms It has been used to assess the frequency, intensity, and type of symptoms felt in the wrists and hands. The evaluation included eleven questions about the following: how often you wake up in the middle of the night because of pain, how bad the pain is during the day, how long it lasts, how numb it is, how weak you are, how tingly it is, how bad the tingling or numbness is during the night, how often you wake up in the middle of the night because of it, and how hard it is to hold tiny things.

Second subscale (Functional Status) Researchers used this tool to see how CTS affected individuals' ability to go about their regular lives. Writing, fastening buttons, holding, gripping, opening jars, carrying, washing, and dressing are the eight daily tasks that make up their entirety.

Boston Carpal Tunnel Questionnaire (BCTQ) system of scoring:

We used a 5-point scale, where 1 was considered normal and 5 was considered extremely severe, to measure the severity of the symptoms. Through statistical analysis, a cumulative total was determined by averaging the eleven components on this scale. To that end, a high symptom severity score indicated that the symptoms were severe. From 1 (no trouble), 2 (some difficulty), 3 (substantial difficulty), 4 (severe difficulty), and 5 (very severe difficulty) was the grading system used for the functional status scale, which had five possible answers. After tallying up each of the eight components of daily activity, statistical analysis yielded the aggregate score for this scale. A higher functional status score, therefore, was indicative with a more severe disability.

Through statistical analysis, the total score for the BCTQ was calculated by averaging all nineteen items. Increased disability and severity of symptoms were associated with higher scores.

Tool III Disabilities of the Arm, Shoulder, and Hand (DASH)

Researchers from the American Academy of Orthopedic Surgeons and the Canadian Institute of Work and Health collaborated to produce the questionnaire **(Soc & Hand, 2012).**

System of scoring: The DASH outcome measure is a 34-item self-reporting questionnaire that aims to evaluate the patient's health status. The degree to which symptoms like pain, activity-related discomfort, tingling, weakness, and stiffness are experienced (5 items), the extent to which these problems impact social functioning, work, and psychological well-being (eight items), and the difficulty level in performing different physical activities (21 items) are all assessed by these items. On a 5-point Likert scale, patients can rate the severity of problems and their impact on daily life for each item.

The entire score is categorized into three distinct segments as follows.

1. Mild dysfunction <50%

2.Moderate dysfunction: 50% - 75%

3. Sever dysfunction ≥75%

Educational Information and Training Practices for nerve gliding Exercise.

Designed by the researchers following review of relevant literature **Nazarieh et al. (2020).** Nerve gliding exercises are

mobilization techniques wherein the fingers are maneuvered through six distinct postures to facilitate the sliding of the hand's flexor tendons.

1) Start by maintaining a neutral wrist position and bending fingers and thumb into a fist, palm facing up.

2) Place thumb and fingers in a neutral, straight line. 3. Bend wrist such that the palm is facing up while maintaining straight fingers and thumb. 4) With the hand still in the same spot, separate the thumb from your hand. 5) Maintaining the identical position of hand and fingers, turn the wrist such that the palm is facing away from you. Sixth, keep your thumb in position 5 and use your free hand to gently pull down. (Figure 1)

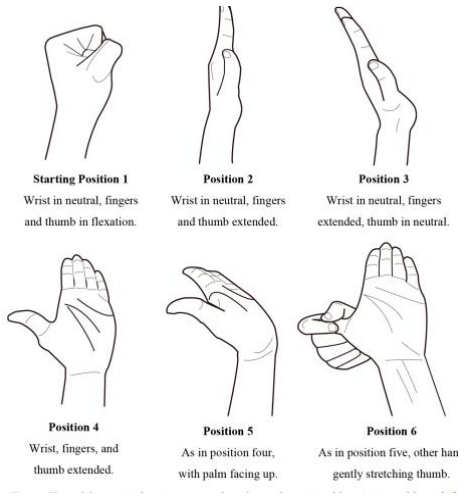

Figure 1. There are six different nerve gliding exercises, each corresponding to a different wrist and finger posture.

It was deployed to assure that patients can conduct nerve gliding exercises perfectly. It is composed of two pre- and two post-operative patient education sessions. Which include 6 types of exercises it was conducted pre/post-surgery, The NGE was began four days postop and performed three times a day during outpatient treatment and self-exercise at home. The NGE is completed in six postures, holding each position for seven seconds. These were performed for five sets. These exercises should be completed in an application within an average of 20 minutes. which were composed in straightforward Arabic brochure and included illustrative images to enhance patients' comprehension.

Ethical considerations

After the Ethics Committee of the Faculty of Nursing gave its preliminary clearance before the first interview, after explaining the study's goals, methods, and potential advantages to the participants, we got their oral and written agreements. The participants were informed that their participation was entirely optional and that they might discontinue at any moment without providing a reason. Coding was used to guarantee that all data obtained would remain confidential, and we assured participants that their data would be utilized only for research purposes.

Content validity:

It was conducted to guarantee that the tools addressed the study's aims. The tools were assessed by five specialists in each specialty and academic position. This included one professor and four assistant professors of medical surgical nursing from Minia University's Faculty of Nursing. Clarity, relevance, thoroughness, comprehension, and ease of execution were the criteria they used to evaluate the product. Upon reviewing their ideas, we made some small revisions and then put out the final edition.

The reliability:

The internal consistency method was used to test each tool. While the DASH questionnaire has a reliability coefficient of 0.96, BCTQ had a Cronbach's alpha reliability coefficient of 0.863. Prior to beginning data collecting, tests were conducted to ensure content validity and reliability.

Pilot study:

As a first step, 10% of the total subjects (6 patients) were used in a pilot study to assess the practicality and accuracy of the tools, in addition to determining how long

it will take to finish each document. After making some minor alterations based on the pilot study's findings, the subjects who participated in the pilot were eventually excluded from the main study.

complete tools I and II, and about 20 minutes to fill out tool III. The data that was gathered was used as a foundation and informed the development of nerve gliding exercises brochure.

Study fieldwork

The following phases were involved in the current study's completion:

Preparatory phase:

The present study started with the creation of a number of tools for gathering data following the investigation of the existing and previous studies in the research by using the internet, textbooks, journals, research papers, and magazines to get a comprehensive image of all aspects of the subject of the study.

The researchers visited previously stated research setting to organize and create recruiting strategies prior to data collection. This stage helped to direct, organize, and create the research process in addition to obtaining official written approval that was granted within a month before the research was conducted.

Data for the study was gathered during the morning shift on two days each week. Data collection: Beginning in November 2023 and ending in July 2024, this period of time was devoted to gathering data and implementing nerve gliding exercises.

Following completion of the "control group," data was gathered from the "study group. “As part of the study, researchers interviewed patients who met the eligibility criteria, explained the study's purpose and nature, and established a rapport with each participant.

Individual interviews took place in the neurosurgery department using data collection tools; each patient took approximately 15-20 minutes to

Planning phase:

Based on patient demands indicated during assessment, researchers created a nerve gliding exercises brochure during this phase. Lectures, small-group discussions, demonstrations, and re-demonstrations were all part of the training procedures. Videos, color posters, and photographs served as the instructional resources. To aid patients in understanding and implementing the information in regard to the study's goal, the researchers additionally developed a nerve gliding exercises plan and an illustrated brochure in easy Arabic.

Implementation phase:

For study group the sessions were conducted in a study setting to implement the nerve gliding exercises. Each patient was interviewed by the researchers separately. The theoretical and practical components of the exercises were spread out over six consecutive sessions.

The first session served as an orientation, outlining the goals of the study, the nerve gliding exercise, the general objectives, the intended learning outcomes, the methods of instruction, the media used for instruction, the activities that learners were expected to do, and the methods for evaluation. The second and third sessions were devoted to the actual demonstration and re-demonstration of the techniques used in the tendon and nerve gliding exercises.

Following a practical demonstration by the researchers, the patients were then allowed to repeat the exercises independently while still being closely monitored by the researchers. This process continued until the researchers were satisfied that the

participants had fully learned the exercises. They were helped to fix any mistakes that participants might have made if needed.

There are six different types of nerve gliding exercises that were done before and after surgery. The exercises were started four days after surgery and were done at least three times daily while receiving outpatient care and while at home. The exercises are performed in six different positions, holding each one for seven seconds.

There are five sets of these exercises. On average, patients were instructed to do them for 20 minutes. The instructions were written in simple Arabic and included pictures to help patients understand. Additionally, patients were given a compact disk (CD) with video-films of the exercises to help them remember. They were also given an educational brusher to help them remember the exercises. In contrast, the control group received just standard hospital treatment.

Evaluation phase:

The last phase of the study was administered six weeks after surgery to the study group that had nerve gliding exercises. The effect of these exercises was evaluated using the BCTSQ and the DASH questionnaire. In contrast, the control group received just standard hospital treatment; researchers assessed symptom intensity and hand function using the same questionnaires.

Statistical Design:

The acquired data was statistically organized, tabulated, and analyzed using Statistical Package for the Social Sciences (SPSS) version 26 for Windows, running on an IBM compatible computer.

To characterize the data, the researchers employed descriptive statistics including percentages, averages, and standard deviations. The means were compared using a dependent (t) test. The researchers used the Pearson correlation coefficient (r) test to look for any association between the study's several variables.

Through the use of multivariate logistic regression, we were able to ascertain whether or not the independent variables were statistically associated with the outcome variable, the intensity of that link, and the directionality of that association. We ensured the trustworthiness of the study tools by utilizing Cronbach's Alpha.

Values at the level were deemed significant when $p \leq 0.05$, and highly significant when $p \leq 0.01$. A statistically significant difference was not considered when $p > 0.05$.

Results of research

Table (1) The average ages of the study and control groups were 46.3 ± 10.4 and 44.7 ± 11 years old, respectively, according to Table (1). Females made up around half of the study participants (53.3%) and the control group (50.0%), and more than three quarters of both groups were married (83.3%). In terms of the participants' level of education, almost a third (33.3%) were illiterate. Finally, almost half of the women in both the study and control groups were housewives. When comparing the two groups according to sociodemographic factors, no significant differences were found.

Table (2): clears that all subjects in the study and control group underwent open carpal tunnel release surgery, since the results show that 83.3% of the participants in the study and 70% of the participants in the control group had surgery on the right hand. No one in the study group or the control group had ever had surgery for carpal tunnel syndrome before (83.3 and 90%, respectively). When comparing the two groups according to present surgical status, no significant differences were found.

Figure (1): displays that there was a

history of diabetes mellitus in more than one third of the study and control groups, respectively, at 46.7% and 30.0%. More than three quarters of those participating in the study group (73.3%) and the control group (86.7%) did not have a history of hypertension.

Table (3): reflects that there was a highly significant difference between the study and control groups in respect to the subscales of the Boston carpal tunnel test (functional status and symptom severity) after the intervention with mean scores of 33.3 ± 7.5

and 71.9 ± 11.7 respectively, and a p-value ≤ 0.001

Table (4) demonstrates that the average scores for the physical parameters as a subscale of the DASH scale were (1.4±0.3) and (3.1±0.4) for the study group and the control group, respectively. Of the study group, 90.0% had mild dysfunction, while 83.3% and 13.3% of the control group, respectively, had moderate to severe dysfunction. The variations between the two groups were highly statistically significant, and the study group showed a significant improvement.

Table (5): clarifies that large portion of study participants (76.7%) had mild to no dysfunction, while approximately half of the control group (40.0% and 50.0%, respectively) had moderate to severe dysfunction as the average scores for the social parameter subscale of the DASH scale were (1.4±0.3) and (3.2±0.5) in study and control groups respectively. There were highly significant differences between the study and control groups, with the study group showing a meaningful improvement.

Table (6): shows that While 40.0% of the control group experienced moderate dysfunction, 86.7% of the study group experienced mild impairment with average scores for the patients' symptom parameters as a subscale for the DASH scale were (1.2± 0.1) and (2.2± 0.4) in study and control groups respectively, there were highly statistically significant differences between the study and control groups and significant improvement for the study group.

Table (7): demonstrates that the average scores for the psychological parameters of the patients as a subscale of the DASH scale were (2.1±0.8) and (3.7±0.9) in study and control groups respectively. While 75.3% of those in the study group disagreed that they were less capable, less confident, or less useful due to issues with

their arms, shoulders, or hands, 56.7% of those in the control group agreed with this statement. There were highly statistically significant differences between the study and control groups regarding improving psychological status post intervention.

Table (8): shows that the mean scores for the patients' work parameter as a subscale for the DASH scale were (1.9±0.5) in the study group and (3.7±0.6) in the control group, approximately three-fifths of those participating in the control group had moderate to severe dysfunction, whereas the highest percentages in the study group were 83.3% and 10.0%, respectively, with minimal to no malfunction. There were highly statistically significant differences between the study and control groups with significant improvement for the study group.

Figure (2): displays the average total DASH scores for patients, which were 50.4± 10.1 and 105.1± 13.2 respectively. The majority 93.3% & 3.3% of study group were having mild to no dysfunction respectively while the highest percentage 83.3%&16.7% among control group were having moderate to severe dysfunction respectively. There were highly statistically significant differences between the study and control groups and significant improvement for the study group.

Table (9): shows that after the intervention, the patients' total scores on the DASH and Boston carpal tunnel scales were positively correlated (p = 0.001), meaning that higher scores on the DASH scale were associated with higher scores

on the BCTS and vice versa.

Table (10): Reveals the model for predisposing factors for Boston carpal tunnel score among the studied patients at post-intervention. Age and the DASH scale were the two most positive predictors of this score during the post-phase, as shown in the table. As r- square indicates, 70.0 % of the variance of Boston carpal tunnel score.

Table (1): Frequency Distribution of the Socio demographic characteristic for both study & control groups participants (n= 60).

Demographic data	Groups				χ^2	*P* – value
	Study (n=30)		**Control (n=30)**			
	No.	%	No.	%		
Age / years						
20- <30	2	6.7%	2	6.7%	.478	.956 NS
30-<40	6	20.0%	7	23.3%		
40-<50	8	26.7%	9	30.0%		
50 - <65	14	46.7%	12	40.0%		
Mean ± SD	46.3±10.4 years		44.7± 11years		t=.574	0.568 NS
Gender						
Male	14	46.7%	15	50.0%	.067	1.000 NS
Female	16	53.3%	15	50.0%		
Marital status						
Single	0	0.0%	1	3.3%	2.605	.545 NS
Married	27	90.0%	25	83.3%		
Widow	2	6.7%	4	13.3%		
Divorce	1	3.3%	0	0.0%		
Residence						
Rural	17	47.2%	19	52.8%	.278	.792 NS
Urban	13	54.2%	11	45.8%		
Educational level						
Illiterate	10	33.3%	12	40.0%	6.605	.161 NS
elementary	6	20.0%	3	10.0%		
Secondary school and diploma	7	23.3%	2	6.7%		
University	5	16.7%	6	20.0%		
Occupation status						
Work	11	36.7%	11	36.7%	1.097	1.000 NS
Penson	1	3.3%	0	0.0%		
Farmer	5	16.7%	6	20.0%		
housewife	13	43.3%	13	43.3%		
Living status						
alone	1	3.3%	0	0.0%	1.870	1.000 NS
With only husband or wife	0	0.0%	1	3.3%		
Living with closed family	29	96.7%	29	96.7%		

NS= not significant

Table (2) Patients' medical history and present surgical status as a percentage of the study and control groups (n= 60).

Medical information and current surgical condition	Groups				χ^2	*P* – value
	Study (n=30)		Control (n=30)			
	No.	%	No.	%		
Location of surgery						
Right	21	70.0	25	83.3	1.491	0. .360 NS
Left	9	30.0	5	16.7		
Type of Carpal Tunnel Release Surgery						
Open surgery	30	100%	30	100%	-	-
Endoscopic surgery	0	0	0	0		
Previous carpal tunnel syndrome surgery						
Yes	5	16.7	3	10.0	.577	.706 NS
No	25	83.3	27	90.0		

NS= not significant

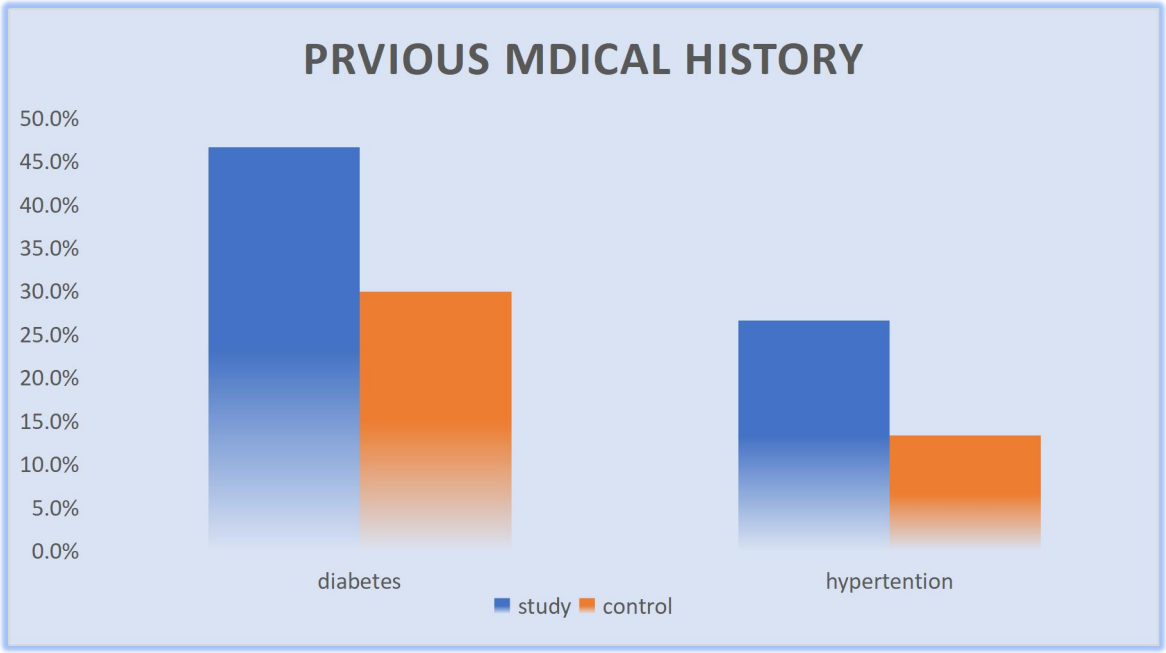

Figure (1): Percentage distribution of patients in the study and control groups based on their previous medical history (n= 60).

Table (3) Percentage distribution patients of both study & control groups regarding Boston Carpal Tunnel Subscales post applied nerve gliding exercises (n= 60).

Carpal Tunnel Subscales		Study (n=30)		Control (n=30)		Test of significance	
	No of items	No.	%	No.	%	t	*P* – value
Symptoms Severity Scale	11	20.5±5.6		41.3±6.0		.049	0.0005**
Functional status scale	8	12.9±1.9		30.4±5.8		14.858	0.000**
Total	19	33.3±7.5		71.9±11.7		3.223	0.000**

N.B NS= not significant * p = ≤.05 (statistical significance) ** p = ≤.01 (highly statistical significance

Table (4) Distribution of patients in the study and control groups by DASH physical parameter following nerve gliding activities. (n= 60).

Physical parameter	Study (n=30)		Control (n=30)		Test of significance	
	No.	%	No.	%	χ^2	*P* – value
Mean ± SD	1.4±0.3		3.1±0.4		t 3.514	.0001**
No dysfunction	3	10%	0	0.0	Fisher exact = 65.663	.0008**
Mild dysfunction	27	90%	1	3.3%		
Moderate dysfunction	0	0.0	25	83.3%		
Sever dysfunction	0	0.0	4	13.3%		

N.B NS= not significant* *p* = ≤.05 (statistical significance) ** *p* = ≤.01 (highly statistical significance)

Table (5) Distribution of patients in the study and control groups after applying nerve gliding exercises, according to the DASH social parameter *(n= 60).*

Social parameter	Study (n=30)		Control (n=30)		Test of significance	
	No.	%	No.	%	χ^2	*P* – value
Mean ± SD	1.4±0.3		3.2±0.5		t 12.586	.0004**
No dysfunction	7	23.3%	0	0.0	Fisher exact = 55.240	.0002**
Mild dysfunction	23	76.7%	3	10.0%		
Moderate dysfunction	0	0.0	12	40.0%		
Sever dysfunction	0	0.0	15	50.0%		

N.B NS= not significant* *p* = ≤.05 (statistical significance) ** *p* = ≤.01 (highly statistical significance)

Table (6) Percentage distribution patients of study & control groups according to DASH symptoms parameters post applied nerve gliding exercises (n= 60).

Symptoms parameter	Study (n=30)		Control (n=30)		Test of significance	
	No.	%	No.	%	χ^2	*P* – value
Mean ± SD	1.2±0.1		2.2±0.4		t 17.656	.0003**
No dysfunction	2	6.7%	0	0.0	Fisher exact =10.356	.003**
Mild dysfunction	26	86.7%	18	60.0%		
Moderate dysfunction	2	6.7%	12	40.0%		
Sever dysfunction	0	0.0	0	0.0		

N.B NS= not significant * *p* = ≤.05 (statistical significance) ** *p* = ≤.01 (highly statistical significance)

Table (7) Percentage distribution patients of both study & control groups by DASH psychological parameters after applied nerve gliding exercises (n= 60).

Psychological parameter	Study (n=30)		Control (n=30)		Test of significance	
	No.	%	No.	%	χ^2	*P* – value
I feel less capable, less confident or less useful because of my arm, shoulder or hand problem.						
Mean ± SD	2.1±0.8		3.7±0.9		t 2.779	.0003**
Strongly disagree	4	13.3%	0	0.0		
Disagree	22	73.3%	4	13.3%	Fisher exact =33.207	.0007**
Neither agree nor disagree	1	3.3%	5	16.7%		
Agree	3	10.0%	17	56.7%		
Strongly disagree	0	0.0	4	13.3%		

N.B NS= not significant * p = ≤.05 (statistical significance) ** p = ≤.01 (highly statistical significance)

Table (8) Percentage distribution patients of both study & control groups according to dash work parameter post applied nerve gliding exercises (n= 60).

Work parameter	Study (n=30)		Control (n=30)		Test of significance	
	No.	%	No.	%	χ^2	*P* – value
Mean ± SD	1.9±0.5		3.7±0.6		t 0.974	.0005**
No dysfunction	3	10.0%	0	0.0	Fisher exact =54.777	0003**
Mild dysfunction	25	83.3%	1	3.3%		
Moderate dysfunction	2	6.7%	17	56.7%		
Sever dysfunction	0	0.0	12	40.0%		

N.B NS= not significant * *p* = ≤.05 (statistical significance) ** *p* = ≤.01 (highly statistical significance)

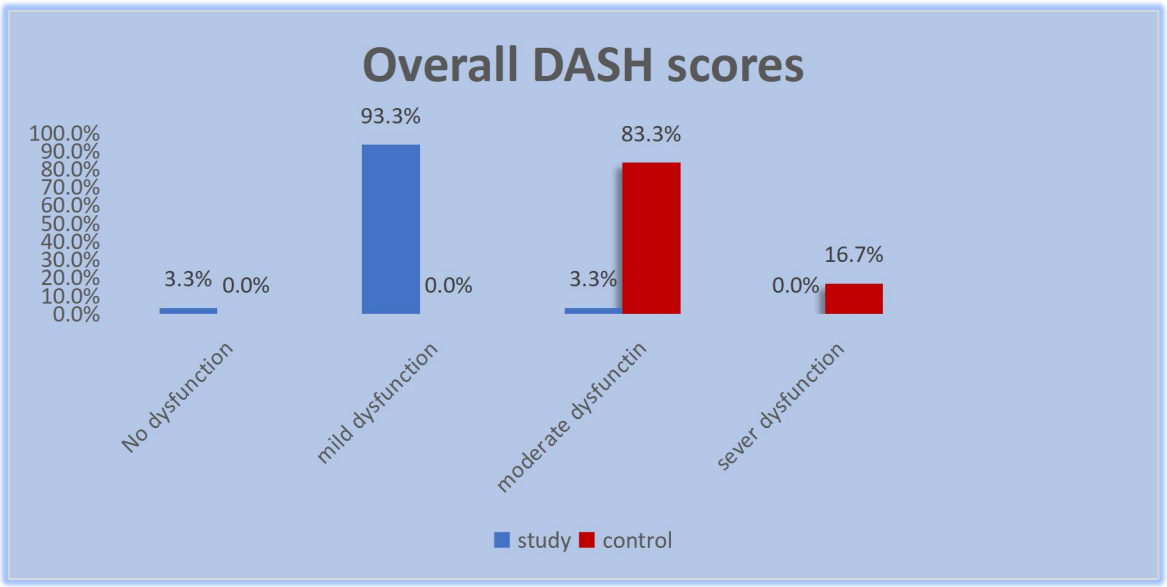

Figure (2): Percentage distribution of patients in the study and control groups based on their overall DASH scores after implementing nerve gliding exercises (n= 60).

Table (9) Correlations between DASH scale and Boston Carpal Tunnel Subscales among both study & control groups after applied nerve gliding exercises (n= 60).

Variables	Boston Carpal Tunnel Subscales			
	Study (n=30)		***Control (n=30)***	
DASH scale	**r**	**p**	**r**	**p**
	.560	0.001**	.795	0.000**

***Correlation is significant at the 0.05 level **Correlation is significant at the 0.01 level**
*** *p* = ≤.05 (statistical significance) ** *p* = ≤.01 (highly statistical significance)**

Table (10): Multiple Linear Regression Model Predisposing Factors for Boston Carpal Tunnel Among the Studied Patients at Post-Intervention.

	Unstandardized coefficient		standardized coefficient	t test	*P* value
	B	SE			
Constant	-2.014-	.422		-4.777-	.000
Age	.022	.007	.259	3.392	.001
Total DASH score	1.126	.100	.821	11.232	.000
Previous carpal	.079	.180	.033	.438	.663
Model summary					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	
	.840	.706	.690	.51264	
ANOVA					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**P. Value**
Regression	35.283	3	11.761	44.752	.000**

Highly significant at P<0.01 T: t-test value. F: ANOVA df: degree of freedom
A. Dependent Variable: Total Boston carpal tunnel.
B. Predictors: (constant): Age, total DASH scale and previous carpal.

Discussion

According to **Sevy & Varacallo (2021)**, CTS comprises nearly ninety percent of the total neuropathy instances and is a particularly common focal mononeuropathy. It happens when the median nerve gets compressed in the carpal tunnel and gets trapped with the other peripheral nerves. Conservative management is usually sufficient for mild cases, but surgical intervention may be necessary for severe cases in order to relieve compression on the median nerve, improve blood flow to the nerves, and therefore lessen clinical symptoms and speed up the recovery of hand function **(Moran et al.,2020).** Research suggests that nerve gliding exercises can slow the development of CTS by decreasing intraneural edema **Çağlar et al., 2024**.

The current study indicated that, with respect to sociodemographic data, the study group's average age was 46.3 ± 10.4 years, while the control group was 44.7 ± 11 years, according researchers point of view this because of it is the age of hard work and tasks that require a lot of manual use. In terms of marital status, over 45% of both groups were married. When it came to gender, about 50% of the study and control groups were female. This might be because of the fact that sex hormones cause a higher incidence of CTS among females, particularly during menopause and pregnancy. These findings were corroborated by **Ramadan & Abdel Maksoud (2021)**, who also found that over 50% of the study and control groups were female, aged 40-60, moreover, most patients in both groups were married.

Additionally, **Genova et al. (2020)** reported that the general population has an estimated yearly prevalence percentage of 3.8% of CTS and the most prevalent age group for CTS, meanwhile, is (40–60). Consistent with previous research, the present results show that 57.0% of female patients and 43.0% of male patients have CTS. This conclusion is supported by **Low et al. (2021)**, and with estimates that 9% of females and 6% of males will experience this syndrome at some point in their lives. In contrast, **Bicha et al. (2024)** discovered a significantly higher prevalence of CTS among male patients.

More than a third of the study and control groups

were illiterate; this finding is consistent with that of **Bekele et al. (2022)**, who noted that 113 (32.0%) of the participants had not completed formal schooling. Over 50% of the women in the study and control groups were housewives. This could be because housewives tend to participate more frequently in activities that contributed stress on the median nerve and cause CTS, these findings were corroborated by **Mathew & John (2021).** when comparing women who did not frequently engage in hand-intensive jobs (female non-manual workers) to those who did, those women reported increased symptoms and exhibited higher level of clinical and electrophysiological impairment. In addition, **El-Sherif et al., (2024)** stated that there was no significant difference between the two groups in terms of female predominance; 57 out of 100 cases and 46 out of 100 controls were female. Those women were merely staying at home to take care of their families.

Moreover **Elbastı et al. (2024)** discovered that 106 (71.1%) of the patients were female, they also noted that housewives had a greater frequency of CTS and the neurophysiological severity was higher compared to other occupations. Housewives made up the largest occupational category among the patient categories included in their analysis (n=94, 63.1%).

The present research found that regarding medical information almost 70% of the participants (both in the study and the control groups) had surgery on their right hand. The researchers speculate that this could be due to the fact that among the many tools needed for everyday life, the right hand is paramount and is the dominant hand for many people who perform extremely repetitive tasks. This finding is corroborated by **Elbastı et al. (2024)**, who discovered that 134 (89.9%) of their participants had CTS on the right hand.

The present study obviated that all of the study and control group subjects (100%) were have open carpal tunnel release surgery from the researchers point of view this may be many people expected that surgery is a safe and successful method for patients with signs and symptoms of CTS who have severe compression, the results of this study are in line with those of **Shin (2019),** who further found that open-approach surgical tunnel release is the preferred treatment for CTS.

The current study result revealed that the majority of study and control group (83.3%&90.0%) did not have previous carpal tunnel syndrome surgery respectively these findings consistent with **Ramadan & Abdel Maksoud (2021)**. who noticed that while the majority of participants in the control and study groups did not have a history of carpal tunnel surgery.

Concerning the chronic illness history of the patients more than a third of patients in both the study and control groups had a history of diabetes mellitus (DM), as revealed by the present study. The glycosylation end products subjected to chronic stress from endoneurial hypoxia may worsen ischemia in nerves, according to researchers' point of view. This finding corroborated that of **Pourmemari & Shiri (2016)**, who had previously shown that CTS could develop in the presence of elevated blood glucose levels as glucose binds to proteins in the carpal tunnel tendons, leading to inflammation and a decrease in the tendons' ability to glide smoothly as blood sugar levels rise, as well as **Sanjari et al. (2024)**, diabetes significantly increased the odds of CTS by 90%. However, this finding contradicts **Low et al. (2021),** who observed no relationship between DM and CTS in adult ambulatory patients.

The present study result indicated that over half of participants from study and control groups had no prior history of hypertension, according to **Alendijani et al. (2023)** also found that 57.6% of CTS patients did not have hypertension, therefore our results are in line with their own.

Concerning BCTQ after gliding exercises, a statistically significant difference was found between the study and control groups in the current study, with mean scores of 33.3 ± 7.5 and 71.9 ± 11.7, respectively. From the viewpoint of the researchers, this result showed how the gliding exercises improved functional status and lowered the severity of symptoms through reducing strain on the median nerve, extending or avoiding adhesions between the nerve and tendons, alleviating tenosynovial edema, and regaining venous return this led to better blood flow in the hands.

Other studies that agreed with these results were those by **Awad et al. (2022) and Naeiji et al. (2021)**, who found that the study group did significantly better on the BCTQ symptom severity scale compared to the monitoring group after the

intervention. These results also agreed with those of **Sault et al. (2020)**, who found that manual therapy treatment improved symptoms and function in individuals with CTS. Furthermore **Wolny & Line (2019)** said that there were significant changes following the intervention, in terms of pain and symptom severity, in the experimental group.

Anwar et al. (2019) and **Ünver & Akyolcu (2018)**, also found that the average severity of symptoms decreased from moderate to mild. This result matched their findings. As far as functional severity is concerned, the average score was too low for mild.

The current study demonstrated that the nerve gliding exercises significantly improved hand function and reduced symptom severity in patients with CTS. This finding is supported by **Ramadan & Abdel Maksoud (2021)**, likewise found statistically significant changes between the experimental and control groups, with the experimental group showing statistically significant improvement with respect to DASH scores following surgery. Overall, the results show that nerve gliding exercises are important for CTS treatment.

The study's findings were also supported by **Bobowik (2019)**, who said that exercises can be used after surgery to help move the median nerve and make the muscles and joints in the upper limbs better in people with CTS.

Also, **Fragala et al. (2019)** said that starting exercise early helps with recovery of daily living tasks, makes shoulder movement better, and keeps people from becoming disabled. In this case, **Zidkova et al. (2019)** revealed that certain exercise methods had a significant positive effect on the symptoms of CTS. The results of this study were also supported by **Rafn et al. (2018)**, who found that starting an exercise program soon after surgery seemed to improve shoulder range of motion, muscle strength, and the ability of the arm to do its job.

The present study's results are similar to those of **Bobowik (2019)**, who said that the symptom intensity scale and functional status scale got better after doing exercises after surgery.

Research carried out by **Marryam et al. (2018)** proved that exercises involving gliding nerves and tendon were useful. The participants in the study reported less severe symptoms when tested using the same scale.

The present findings demonstrated a positive correlation coefficient between total BCTQ and total DASH scale among the studied patient's post-intervention at p- value = 0.001. From the viewpoint of the researchers, this outcome demonstrated the impact of the therapies involving post-surgical gliding exercises on improving functional status and alleviating symptoms. **Awad et al. (2022)** also found a pain, functional status, the ability to do normal and special activities and the intensity of symptoms are positively correlated in the patients they studied before and after the intervention. This result matched their findings. Before intervention, all of the things had high scores, which is the worst outcome. After intervention, the scores went down, which is the best outcome.

Anwar et al. (2019) also found that the mean values for symptom severity in the study decreased from moderate to mild symptoms category, which was consistent with our results.

The present study explored that there were significant positive predictors of this score throughout post phase were age and DASH scale. As r- square indicates, 70.0 % of the variance of BCTQ score. According to **Awad et al. (2022),** who confirmed earlier findings, predisposing factors for both the Boston carpal tunnel score and the patient-rated wrist evaluation score post-intervention included factors such as age, degree of education, profession, length of time with hand symptoms, frequency of illness, and patient-rated assessment of the wrist. Patients between the ages of 40 and 60 have the highest prevalence of CTS, and the likelihood of having CTS rises 30% every decade among those of working age, according to research by **Alsharif et al. (2017).** This points to degenerative processes brought on by increasing hand activity as the probable cause of median nerve injury.

Conclusion

Our study's findings brought us to the conclusion that the nerve gliding exercises applied to postoperative CTS patients considerably ameliorated symptoms, enhanced functional status, and diminished arm, shoulder, and hand disabilities. Furthermore, a positive correlation was found between functional status and symptom severity in the study groups after nerve gliding exercise interventions, lending credence to the research hypotheses.

Recommendations

The current study's findings support the following recommendation:

- Establishing in-service educational program to educate nurses and patients on the importance of nerve gliding exercises in treating and alleviating the severity of CTS symptoms.
- High-probability groups should have easy access to a brochure that explains nerve gliding exercises and lifestyle changes in simple language with a variety of simple images.
- Attendance at conferences and workshops pertaining to the care of patients with CTS should be strongly encouraged.
- For more broadly applicable findings, it would be helpful to repeat the present study with a bigger probability sample from various geographic locations.

Ethical Approval:

The Clinical Research Ethics Committee of Minia University approved the study statement of evaluating post-surgery nerve gliding exercise among patients with carpal tunnel syndrome for hand function and symptoms severity.

Informed Consent:

Informed consent was obtained from all patients to be included in the study.

Declaration of Conflicting Interests:

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article

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