The Effect of Nursing Rehabilitation Program on Symptoms Severity and Functional Status in Patients with Carpal Tunnel Syndrome Undergoing Surgery.

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Abstract:

Background: Carpal Tunnel Syndrome (CTS) is the most common upper extremity peripheral compression neuropathy and typically occurs because of the compression and damage of the median nerve between the transverse carpal ligament and flexor tendons in the carpal tunnel of the wrist. **Objectives**: was to assess the effect of the rehabilitation program on symptoms severity and functional status in patients with carpal tunnel syndrome undergoing surgery. **Setting**: The study was conducted at the Neurosurgery Department of Alexandria Main University Hospital and the affiliated Outpatient Clinic. **Subjects**: This study comprised a convenient sample of 40 adult patients admitted to the above-mentioned setting and diagnosed with carpal tunnel syndrome undergoing surgery. The study subjects were divided randomly into two equal groups; a study group, consisting of 20 adult patients who received the program and control consisting of 20 adult patients who received the routine hospital care only. **Tools**: Three tools were used Tool I: Patient's Sociodemographic Characteristics and clinical data tool, Tool II: Carpal Tunnel Syndrome Questionnaire, and Tool III The Disabilities of the Arm, Shoulder, and Hand. **Results**: There were highly statistically significant differences between the study and control regarding pain intensity 1 month after the surgery. It was found that significant improvement among the study group, after fourteen days and one month postoperatively concerning the disabilities of the arm, shoulder, and hand. A statistically significant improvement in the symptom severity and functional status was noticed among the study group. **Conclusion**: Applying for a rehabilitation program significantly enhanced the studied patients' pain intensity, disabilities of the arm, shoulder, and hand., symptom severity, and functional status postoperatively than their control. **Keywords -** Carpal Tunnel Syndrome, Nursing Rehabilitation Program, Symptoms Severity, Functional Status

Keywords: Nursing, Rehabilitation, Symptoms, Functional Status, Carpal Tunnel, Surgery

Introduction

Technology is an integral part of daily life: cell phones, computers, and tablets. In some way, everyone seems to be connected to technology. This connection even applies to healthcare workers. More and more patient and healthcare information are available through various technologic methods. However, some unexpected side effects may be experienced. The repetitive motions associated with technology usage increase the risk of developing injuries such as carpal tunnel syndrome (CTS) **(Sharief et al., 2018)**

Carpal Tunnel Syndrome (CTS) is the most common upper extremity peripheral compression neuropathy (**Zwolińska & Kwolek, 2019)** because of the compression and damage of the median nerve between the transverse carpal ligament and flexor tendons in the carpal tunnel of the wrist **(Beran, 2015).** The female to male ratio having carpal tunnel syndrome is 3 to 1**(Amir et al., 2018).** CTS is bilateral in 59% of patients. Recurrent overuse of muscles and joints, using vibrating devices, physical injuries, fractures, sex, age, pregnancy, metabolic diseases, and connective tissue diseases are etiological factors of CTS. CTS restricts functionality and physical activity levels and causes problems in daily living activities **(Tanriverdi et al., 2019).**

The healthcare provider diagnoses CTS thorough physical examination and testing. Common electrophysiological tests include nerve conduction studies and the electromyogram (EMG). A nerve conduction study determines if signals are being conducted effectively in the hand and arm. Two electrodes are attached to the skin and a small shock is transmitted. As the shock passes through the median nerve, the speed of the electrical impulse is determined. With CTS, electrical impulses are slowed. EMG measures muscle electrical activity to identify any nerve or muscle damage. During an EMG, a thin-needle electrode is placed into a specific muscle. The electrical activity then is evaluated as muscles rest and contract **(Scanlon et al., 2015)**

Paresthesia (numbness, tingling, and burning) affecting the median distribution of nerves (first 3 digits and median half of the 4th finger) along with deep pain in the hand and wrist are the main symptoms of this syndrome. These symptoms are intermittent and worse at night where the patient is awakened from sleep and relieve the discomfort by vigorously shaking the hand. **(Chowdhury & Chakraborty, 2017).** This syndrome leads to weakness and atrophy of the thenar muscle in advanced stages, decreased sensation, reduced muscle strength, and positive irritation tests leading to hand disability. **(Salehi et al., 2019)**

CTS occasionally causes permanent damage to the median nerve without prompt care (some or all nerve fibers are destroyed) and results in transient or permanent sensory or motor dysfunction for the patient. So, choosing proper treatment for CTS is important for improving life quality and decreasing medical costs **(Salehi et al., 2019).** The American Academy of Orthopedic Surgeons recommends beginning with conservative treatment and seeking another non-operative treatment or surgery if it does not relieve the symptoms within 2-7 weeks(Ono et al., 2011), **(Tanriverdi et al., 2019).**

The treatment of CTS is conservative, including splints to hold the wrist in a neutral position, especially at night, topical corticosteroids, non-steroidal anti-inflammatory medications, therapeutic ultrasound, yoga, acupuncture, and surgical management, particularly in advanced conditions. **(Zidkova et al., 2019).**

Although recent studies have been observed that using splints and steroids is useful as primary treatments to improve the symptoms of patients, the effects of these methods are usually temporary and transient **(Ono et al., 2011)**. Furthermore, each of these methods often has its side effects, such as gastrointestinal, hepatic, and renal complications with the use of oral steroidal and non-steroidal anti-inflammatory drugs and tendon rupture, and increased the risk of nerve damage after localized corticosteroid injection**(Salehi et al., 2019).**

Nurses play an essential role in assessing and implementing interventions that advance viable help with pain relief. The nurse should instruct the patient on workplace adaptations that can minimize symptoms of CTS. Workstations should accommodate correct movements of the hands, wrists, and forearms. Forearms should be parallel to the floor. Wrists should be straight with the elbows relaxed at 90 **(Mantzari et al., 2019)** The patient should be coached to pay close attention to hand positioning. For example, the nurse should remind the patient to avoid keeping the hand flexed in the same position for a prolonged period with activities such as driving or cell phone usage. When typing, the patient should avoid applying excessive force to the keyboard. Taking breaks is important so the hand position can be changed. This allows the muscles in the hands and arms to be stretched **(Blevins, 2020).**

In exercise training, which has a protective impact against injury, strength can be a significant factor in reducing the cellular damage that results from repetitive activity and increasing muscle strength. The application of gliding exercises can affect the "stretching of adhesion in the carpal tunnel, widening the longitudinal area of contact at the transverse carpal between the median nerve (**Swords, 2018).** Via encouraging venous return or edema in the median nerve, these exercises can have a positive effect on CTS. The carpal tunnel will return to its usual size by extending and lengthening the restrictive flexor muscles that "close" the hands and strengthening and shortening the extensor muscles that "open" the hands. Reducing tendon and median nerve impingement often reduces friction and eliminates friction and carpal tunnel symptoms **(Raja k Kutty, 2018).**

Significance of the Study

Carpal tunnel syndrome is the most common peripheral nerve entrapment syndrome worldwide and is caused by chronic compression of the median nerve as it enters the carpal tunnel **(Swords, 2018).** The National Institute of Neurological Disorders and Stroke (NINDS) describe carpal tunnel syndrome (CTS) as the “most common and widely known of the entrapment neuropathies in which the body’s peripheral nerves are compressed or traumatized. The high prevalence of carpal tunnel syndrome, its effects on quality of life, and the cost that disease burden generates to health systems make it important to identify the research priorities that will be resolved in clinical trials **(Padua et al., 2016)**.

Carpal Tunnel Syndrome (CTS) is one of the technological diseases of the modern era. Some are caused by occupational exposures, and are marked with direct professional relation, or the action of harmful effects in the workplace **(Tiric-Campara et al., 2014).** CTS can be caused by long-term load and physical effort, and are tied to specific occupations, such as occupations associated with prolonged sitting, working at the computer and work related to the fixed telephone communication**(Pereira et al., 2013).**

Without treatment, CTS can have a negative impact on a person's quality of life. Eventually, the median nerve can become severely damaged, and there may be permanent numbness in the fingers and permanent weakness in the muscles that are innervated by the median nerve So, choosing proper treatment for CTS is important for improving life quality and decreasing medical costs **(Salehi et al., 2019).**

Nurses in neurosurgery practice settings encounter patients with pain because of CTSs and they struggle to manage it. Nurses play an essential role in assessing and implementing interventions that advance viable help with pain relief **(Banschbach, 2016).** The nurse plays a key role in dispensing accurate information about the proper use of body mechanics how to maintain good posture while working and during daily activities, and how to perform certain exercises to treat and prevent recurrence of symptoms. That's why our objective from that research was to assess the effect of the nursing rehabilitation program on symptom severity and functional status in patients with carpal tunnel syndrome undergoing surgery.

Aim of the study:

The study was aimed to assess the effect of the rehabilitation program on symptom severity and functional status in patients with carpal tunnel syndrome undergoing surgery.

Research hypothesis:

- Patients undergoing Carpal Tunnel Syndrome Surgery, who receive Nursing Rehabilitation Program exhibit decrease in Symptoms Severity than those who do not.
- Patients undergoing Carpal Tunnel Syndrome Surgery, who receive Nursing Rehabilitation Program exhibit improved in Functional Status than those who do not

Subjects and Methods:

Research design:

A quasi-experimental design was used in this study to test causal hypotheses and identify a comparison group that is as similar as possible to the treatment group in terms of baseline (pre-intervention) characteristics. The comparison group captures what would have been the outcomes if the programe had not been implemented .Hence, the programe can be said to have caused any difference in outcomes between the intervention and comparison groups. **(White& Sabarwal 2014)**

Setting:

The study was conducted at the Neurosurgery Department of Alexandria Main University Hospital and the affiliated Outpatient Clinic.

Inpatient Neurosurgery department of Alexandria Main University Hospital, located at the fourth and six floors, the fourth floor has a capacity of twenty-four beds for male patients, the six floors has a capacity of twenty beds for female patients. The affiliated Outpatient Clinic receives patients from 8 am to 11 am; 5 days/week. This hospital offer non paid public services.

Subjects:

A purposive sample was used to achieve the aim. It included 40 adult patients admitted to the above-mentioned setting and diagnosed with carpal tunnel syndrome undergoing surgery. The study subjects were divided randomly into two equal groups; a study group, consisting of 20 adult patients who received the program and control consisting of 20 adult patients who received the routine hospital care only As medication administration as doctor prescription, vital signs monitoring.

The patients, who participated in this study, were chosen based on the next criteria:

- **Patients' inclusion criteria included adult patients:**

1.Age ranging from 20-60 years.

2.Patients with non-recurrent or recurrent carpal tunnel syndrome

3. Patients Free from any additional chronic conditions (rheumatic disorders, osteoporosis, spinal fracture diabetes mellitus, and heart disease).

4.Patients, who can communicate verbally, alert, and follow instructions.

5.Patients are willing to participate in the study.

Tools of the study

Tool 1: Patients interview questionnaire: It consists of 4 parts

Part 1: Patient's Sociodemographic Characteristics: This part included data such as; age, sex, educational level, marital status, and occupation.

Part 2: Work organizational variables(Bao et al., 2016)**.**

This part included questions about work organizational variables with the answer yes or no.

1.Do not work overtime

2.Work overtime

3.Do not have a 2nd job

4.Have a 2nd job

5.Repetitively holding hand in one position

6.Rapid "trigger" finger movements

7.Repetitive pressing with hands

8.Frequent (>2/3 of the time) wrist flexion and extension

9.Frequent sustained forceful motion

10. Frequent bending and twisting of the hands or wrists for 3.5 – 6 hours a day

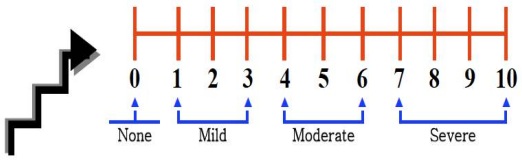
11. Mouse use of more than 20 hours a week

Part 3: Patients' Clinical Data: This part included data such as medical history, surgical history, operation name, duration of disease, names of prescribed medications, and previous carpal tunnel syndrome surgery.

Part 4: pain assessment: it was developed by the researcher after reviewing relevant literature to assess pain characteristics that included: site, radiation, and quality, duration, aggravating factors, and relieving factors**(Dansie & Turk, 2013).**

Scoring system

Numerical pain scale from 0 to 10. 0 means no pain; one to three means mild pain; four to six is considered moderate pain; seven and above is sever pain



Tool II: Carpal Tunnel Syndrome Questionnaire (CTSQ)

Boston Carpal Tunnel Questionnaire. The BCTQ is a standardized, patient-based outcome measure of symptom severity and functional status in patients with carpal tunnel syndrome**(Alanazy et al., 2019)**.

- The questionnaire was self-administered to evaluate the severity of symptoms and functional status in patients with CTS. The questionnaire was self-administered. The symptom severity scale (SSS) measures the severity, frequency, duration, and type of symptoms.

Scoring system

- The scale consists of eleven questions with multiple-choice responses, scored from one point (mildest) to five points (most severe). The overall symptom severity score is calculated as the mean of the scores for the 11 individual items.
- The functional status scale (FSS) evaluates the impact of the CTS on daily living.
- The scale consists of 8 questions with multiple-choice responses, graded from 1 point (no difficulty with the activity) to 5 points (cannot perform the activity at all).
- The overall score for functional status was calculated as the mean of all eight. Thus, higher symptom severity or functional status score indicates worse symptoms or dysfunction.

The total score divided into four categories as the following

- Minimal difficulty <50%
- Mild difficulty -50% <65%
- Moderate difficulty 65 %- <85%
- Severe difficulty ≥85%

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

- The questionnaire was designed jointly by researchers at the Institute of Work and Health in Canada and the American Academy of Orthopaedic Surgeons**(Soc & Hand, 2012).**

Scoring system

- (DASH) outcome measure is a self-report questionnaire of 30 items designed to determine the health status of the patient. The items evaluate the degree of difficulty in carrying out various physical activities due to problems with the arm, shoulder, and hand (21 items),), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness, and stiffness (five items) and the impact

of the problem on social functioning, work, sleep and self-image (four items).

- Each item has five response options that patients can rate difficulty and interference with daily life on a 5-point Likert scale. The scores are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability).

The total score divided into three categories as the following

- Low disability <50%
- Moderate disability 50 %- <75%
- High disability ≥75%

Nursing Rehabilitation Program

1.The program was developed after reviewing related literature, the content of this program included exercise training and patient health education about causes, signs and symptoms, diagnostic procedures, and ways of management and prevention.

2.The developed program was implemented to patients of the study group individually in the inpatient department.

3. It included 2 sessions of patient's teaching during preoperative, 2 days post-operative.

4.Teaching to the patients in the study group was given according to the following schedule: -

A. First sessions

- During: **-** Preoperative period

- Duration of the session**: -** It lasted about 30-60 Minutes

- Emphasizing**: -** Simple explanation about anatomy, causes, manifestations of carpal tunnel syndrome, and ways of management

- The discussion was utilized as teaching methods using a health education booklet prepared previously by the researcher.

B. Second Session

- During: **-** the 2nd postoperative day

- Duration**: -**It lasted about 30-60 Minutes

- Emphasizing: the following exercise, wrist extension stretch, wrist flexion stretch, medial nerve glides, tendon glides

- the researcher instructed the patients that stretch should be done throughout the day, especially before activity, after recovery, as well as the researcher, focused that stretch should be included as part of a warm-up to activities that involve gripping. and the exercise should be repeated 5-10 times per day.

- The demonstration, the discussion were utilized as teaching methods using a health education booklet prepared previously by the researcher. The family was included whenever possible.

Ethical Consideration:

- An official letter was obtained from the administrative office of the Faculty of Nursing

- Written approval was obtained from the hospital administrator and head of the neurosurgery department, after an explanation of the study aim.

- Tool I was developed by the researchers after reviewing related literature.

- Tool II&III it was adopted from the Boston carpal tunnel questionnaire and Dash questionnaire

- Tools and booklet were tested for content validity, completeness, and clarity of items by five faculty staff of Medical-Surgical Nursing and five Neurosurgeons in Alexandria University.

Method

Validity and reliability:

The validity of the tools was ensured by a group of subject experts, medical and nursing staff, who reviewed the tools for accuracy. Furthermore, they were asked to judge the comprehensiveness and clarity of the items. Consideration was given to suggestions and adjustments. The reliability of the tools was measured by Cronbach's alpha test tool I=0.95 and tool II=0.80, indicating reliable tools.

Pilot study:

- A pilot study was done on six patients for testing, clarity, feasibility, and applicability of the developed tool.

Field Work:

- Data were collected in 9 months started (from January 2020 to September 2020) by the researchers.

- Forty adults' patients were recruited according to the previously mentioned inclusion criteria and assigned into two sequential equal groups as follows:

- **Group (1):** subjects maintained on the routine hospital care only as medication administration as doctor prescription, vital signs monitoring.
- **Group (2):** subjects received the nursing rehabilitation program.

- Initial assessment of all patients (study and control group) was done preoperatively using tool (I, II, III) to collect baseline data.

- The assessment was done for every patient individually after careful listening and documenting his or her history, and assessment ranged from 40-60 minutes on individual sessions depending on the degree of tolerance and response of the patients.

- The program was developed after reviewing related literature, the content of this program included exercise training and patient health education about causes, signs and symptoms, diagnostic procedures, and ways of management and prevention.

- The developed program was implemented to patients of the study group individually in the inpatient department.

- It included 2 sessions of patient's teaching during preoperative, 2 days post-operative.

- After program application, every patient in the study and control group was evaluated two times after two weeks, and one-month post-discharge using tool clinical part in tool I, tool II, and III at the affiliated out-patients' clinic.

Statistical Analysis

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**.** **(**Armonk, NY: IBM Corp**)** Qualitative data were described using number and percent Quantitative data were described using range (minimum and maximum), mean, standard deviation. Significance of the obtained results was judged at the 5% level.

The used tests were

1 - Chi-square test

For categorical variables, to compare between different groups

2 - Fisher's Exact or Monte Carlo correction

Correction for chi-square when more than 20% of the cells have expected count less than 5

3 - Student t-test

For normally distributed quantitative variables, to compare between two studied groups

4 - ANOVA with repeated measures

For normally distributed quantitative variables, to compare between more than two periods or stages

5 - Friedman test

For abnormally distributed quantitative variables, to compare between more than two periods or stages.

Results

Table (1) shows the frequency distribution of the study and control subjects according to their sociodemographic characteristics Regarding patient's gender, it is noticed that, more than half of study and control groups (60%) were females .For patient's age, the results revealed that more than half of study and control groups (60%, 55%) ,respectively were aged from **(40 <60)**years old. **Concerning marital status**, the majority of the studied patients 80% in the study group and all subjects 100 % in control group were married .**In relation to the educational level**, it was observed that half of the study (50 %) were university graduates. **In relation to occupation**, it was observed that considerable percentages of both study and control group subjects (60%,40%) were clerical ,respectively. No statistical significant differences were elicited between the two group subjects in relation to sociodemographic characteristics.

Table (2) shows the frequency distribution of the study and control groups

according to their clinical data. For medical treatment after surgery, it is obvious that all of the study and control group subjects (100%) were on corticosteroids. non steroidal anti-inflammatory ,muscle relaxant and analgesics . **It was noticed that** the **more than half of** study groups 70% had **symptoms** for more than one year **before intake** of prescribed **medication Concerning the medical history ,** 70) of the study group and 60% of control subjects had diabetes mellitus**. Only 20% of the study group had history of previous carpel tunnel surgery.** No statistical significant differences were elicited between the two group subjects in relation to their clinical data

Table (3) shows the comparison between the two studied groups according to work organizational variables , The table reveals that 90 % of the study group and all subjects of the control group holding hand in one position repetitively ,had rapid "trigger" finger movements , pressing with their hands repetitively , had frequent (<2/3 of the time) wrist flexion and extension ,also sustained forceful motion , bending and twisting of their hands. The same table portrays that the majority 80% of the study group and 60 % of the control group worked overtime and 45% of the study group had second job

Table (4) illustrates the comparisons between the two subjects according to pain assessment: In relation to the site of the pain all subjects 100 % of the study group subjects had pain in the right arm and only 20 % of the control group had pain in left arm Regarding to severity of pain, in the preoperative period the results reflected that (100%) of the study and control subjects were complained from severe pain then improved after one month to be more than half (65%) had mild pain compared with control subjects, only (20%) had mild pain after one month .This table shows that there were statistical significant differences between the two groups subjects regarding pain severity after fourteen days and one months postoperatively where (p= 0.035 ,0.015,respectively .) . All of the study and control subjects experienced continuous tingling pain pre operatively and after one month all of the study had intermittent pain .Also ,this table shows that there were statistical significant differences between the two groups subjects regarding pain duration after fourteen days and one month postoperatively where (p= 0.047 ,0.001,respectively)

Table (5): Illustrated the comparison between the two studied groups according to the disabilities of the arm, shoulder and hand items throughout period of study .There were significant differences between the study and control groups and significant improvement for the study group , after fourteen days and one month post operatively in relation to the DASH items

Table (6) shows the total scores for study and control groups throughout follow period of study, 75% of the study group had minimal disability one month postoperatively while 40% of control group had minimal disability ,it was observed that there is ahighly significance difference among them throughout the follow period of the study where p <0.001 one month post operatively

Table (7): Reflect comparison between the studied patients according to Boston carpal tunnel items throughout period of study .There was a significant difference between the study and control groups throughout the period of the study at fourteen days and one month operatively .

Table (8): showed that that there were highly significant difference between the study and control subjects after fourteen days and one month postoperatvely where p<0.001

Table (9): Reflect Correlation between the disabilities of the arm, shoulder and hand regarding age and occupation throughout period of study it was found that there is significant positive correlation between DASH and age where p = 0.001 also between dash and the occupation where p=0.044

Table (10): Reflect Correlation between Boston carpal tunnel items regarding age and occupation preoperatively, it was found that there were significant positive correlation between CTS and age where p = 0.008 also between dash and the occupation where p=0.001**.**

Table (1): Frequency distribution of the study and control subjects according to their sociodemographic characteristics (n=40)

Part I: Patients socio–demographic characteristics	Study (n = 20)		Control (n = 20)		χ^2	p
	No.	%	No.	%		
gender						
Male	8	40.0	8	40.0	-	-
Female	12	60.0	12	60.0		
Age (Years)						
30 < 40	5	25.0	9	45.0	3.773	^{MC}p= 0.188
40 < 60	12	60.0	11	55.0		
50 – 59	3	15.0	0	0.0		
Marital						
Married	16	80.0	20	100.0	3.690	^{MC}p= 0 .107
Divorced	2	10.0	0	0.0		
Widow	2	10.0	0	0.0		
Level of education						
Illiterate	2	10.0	4	20.0	5.873	^{MC}p= 0 .194
Read and write	0	0.0	4	20.0		
Primary	2	10.0	1	5.0		
Secondary	6	30.0	5	25.0		
University	10	50.0	6	30.0		
Occupation						
Clerical	12	60.0	8	40.0	3.057	^{MC}p= 0.381
Farmer	1	5.0	0	0.0		
House wife	5	25.0	8	40.0		
Others (university staff)	2	10.0	4	20.0		

χ^2: **Chi square test** MC: **Monte Carlo** *p: p value for comparing between the **two** studied groups
*: Statistically significant at $p \leq 0.05$

Table (2): Frequency distribution of the study and control subjects according to their clinical data (n=40)

Part II: patient's Clinical data	Study (n = 20)		Control (n = 20)		χ^2	p
	No.	%	No.	%		
prescribed medication						
1. Corticosteroids	20	100.0	20	100.0	–	–
2. No steroidal anti- inflammatory	20	100.0	20	100.0	–	–
3. Muscle relaxant	20	100.0	20	100.0	–	–
4. Analgesics	20	100.0	20	100.0	–	–
5. Narcotics	8	40.0	8	40.0	0.000	1.000
6. Never tonic	**8**	**40.0**	**6**	**30.0**	0.440	0.507
Duration of symptoms before medication in take						
< 6 months	2	10.0	0	0.0	4.779	^{MC}p= 0.057
6 months - < 1 year	4	20.0	10	50.0		
> one year	14	70.0	10	50.0		
Medical history						
No	**6**	**30.0**	8	40.0	2.057	^{FE}p= 0.342
Yes(DM)	**14**	**70.0**	12	60.0		
Previous carpel						
No	16	80.0	20	100.0	4.444	^{FE}p= 0.106
Yes (From 3 years**)**	**4**	**20.0**	**0**	**0.0**		

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact**
p: p value for comparing between the **two** studied groups

Table (3): Comparison between the two studied groups according to work organizational variables (n=40)

Work Organizational Variables	Study (n = 20)		Control (n = 20)		χ^2	p
	No.	%	No.	%		
Work overtime	16	80.0	12	60.0	1.905	0.168
Have a 2nd Job	9	45.0	4	20.0	2.849	0.091
Repetitively holding hand in one position	18	90.0	20	100.0	2.105	^{FE}p=0.487
Rapid "trigger" finger movements	18	90.0	20	100.0	2.105	^{FE}p=0.487
Repetitive pressing with hands	18	90.0	20	100.0	2.105	^{FE}p=0.487
Frequent (<2/3 of the time) wrist flexion and extension	18	90.0	20	100.0	2.105	^{FE}p=0.487
Frequent sustained forceful motion	18	90.0	20	100.0	2.105	^{FE}p=0.487
Frequent bending and twisting of the hands	18	90.0	20	100.0	2.105	^{FE}p=0.487
Mouse use of more than 20 hours a week	18	90.0	15	75.0	1.558	^{FE}p=0.407

χ^2: **Chi square test** FE**: Fisher Exact- *** p: p value for comparing between the **two** studied groups

Table (4): Comparison between the two studied groups according to patient's pain assessment before and after rehabilitation program implementation (n=40)

Pain assessnent	Study(n = 20)							Control(n = 20)								
	Before		14day after		one month after		Fr (p_0)	Before		14day after		one month after		Fr (p_0)	χ^2 (p_1)	χ^2 (p_2)	χ^2 (p_3)
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%				
Site																	
Rt arm	20	100.0	20	100.0	20	100.0	–	16	80.0	16	80.0	16	80.0	–	4.444	4.444	4.444
Lt arm	0	0.0	0	0.0	0	0.0		4	20.0	4	20.0	4	20.0		^{FE}p=0.106	^{FE}p=0.106	^{FE}p=0.106
Severity																	
Severe	20	100.0	2	10.0	3	15.0	26.712*	20	100.0	8	40.0	5	25.0	25.265*	–	5.682*	8.426*
Moderate	0	0.0	16	80.0	4	20.0	(<0.001*)	0	0.0	12	60.0	11	55.0	(<0.001*)		(^{MC}p=0.035*)	^{MC}p=0.015*
Mild	0	0.0	2	10.0	13	65.0		0	0.0	0	0.0	4	20.0				
Quality																	
Burring	4	20.0	6	30.0	6	30.0	4.000(0.135)	5	25.0	7	35.0	7	35.0	4.000(0.135)	0.143(^{FE}p=1.000)	0.114(1.000)	0.114(1.000)
Tingling	20	100.0	16	80.0	16	80.0	5.333 (0.069)	20	100.0	18	90.0	18	90.0	4.000(0.135)	–	0.784(^{FE}p=0.661)	0.784(^{FE}p=0.661)
Others	0	0.0	2	10.0	0	0.0	4.000(0.135)	0	0.0	0	0.0	0	0.0	–	–	2.105(^{FE}p=0.487)	–
Duration																	
Intermittent	0	0.0	16	80.0	20	100.0	33.600*	0	0.0	10	50.0	10	50.0	20.000*	–	3.956*	13.333*
Continuous	20	100.0	4	20.0	0	0.0	(<0.001*)	20	100.0	10	50.0	10	50.0	(<0.001*)		(0.047*)	(<0.001*)
Aggravating factors																	
Stress	18	90.0	14	70.0	12	60.0	5.600 (0.061)	20	100.0	16	80.0	16	80.0	8.000*(0.018*)	2.105(^{FE}p=0.487)	0.533(0.465)	1.905(0.168)
Carrying heavy objects	18	90.0	10	50.0	4	20.0	21.143*(<0.001*)	20	100.0	20	100.0	16	80.0	8.000*(0.018*)	2.105(^{FE}p=0.487)	13.333*(<0.001*)	14.400*(<0.001*)
Prolonged hand work	20	100.0	8	40.0	6	30.0	24.571*(<0.001*)	20	100.0	16	80.0	16	80.0	8.000*(0.018*)	–	6.667*(0.010*)	10.101*(0.001*)
Exposure to a cold	18	90.0	6	30.0	6	30.0	20.571*(<0.001*)	20	100.0	16	80.0	16	80.0	8.000*(0.018*)	2.105(^{FE}p=0.487)	10.101*(0.001*)	10.101*(0.001*)
Others	2	10.0	2	10.0	0	0.0	4.000(0.135)	0	0.0	0	0.0	0	0.0	–	2.105(^{FE}p=0.487)	2.105(^{FE}p=0.487)	–
Alleviating factors																	
Rest	20	100.0	20	100.0	16	80.0	8.000*(0.018*)	20	100.0	18	90.0	18	90.0	4.000(0.135)	–	2.105(^{FE}p=0.487)	0.784(^{FE}p=0.661)
Sleep	20	100.0	19	95.0	15	75.0	8.400* (0.015*)	20	100.0	18	90.0	18	90.0	4.000(0.135)	–	0.360(^{FE}p=1.000)	1.558(^{FE}p=0.407)
Medication	20	100.0	14	70.0	10	50.0	15.200* (0.001*)	20	100.0	18	90.0	18	90.0	4.000(0.135)	–	2.500(^{FE}p=0.235)	7.619* (0.006*)
Other s	4	20.0	4	20.0	2	10.0	4.000(0.135)	0	0.0	0	0.0	0	0.0	–	4.444(^{FE}p=0.106)	4.444(^{FE}p=0.106)	2.105(^{FE}p=0.487)

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **Fr**: **Friedman test**
p_0: p value for comparing between the studied periods in each group
p_1: p value for comparing between the **two** studied groups in **before**
p_2: p value for comparing between the **two** studied groups in **14day after**
p_3: p value for comparing between the **two** studied groups in **one month after**
*: Statistically significant at $p \leq 0.05$

Table (5): Comparison between the two studied groups according to the disabilities of the arm, shoulder and hand items before and after rehabilitation program implementation . (n=40)

DASH	Study(n = 20)							Control(n = 20)								
	Before		14day after		one month after		Fr (p_0)	Before		14day after		one month after		Fr (p_0)	χ^2 (p_1)	χ^2 (p_2)	χ^2 (p_3)
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%				
1.Open a tight or new jar																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	2	10.0	2	10.0				
Mild Difficulty	0	0.0	0	0.0	9	45.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	18	90.0	7	35.0	38.000* (<0.001*)	0	0.0	10	50.0	15	75.0	24.441* (<0.001*)	5.682* (^{MC}p=0.036*)	7.391* (^{MC}p=0.025*)	15.945* (^{MC}p<0.001*)
Severe Difficulty	12	60.0	2	10.0	0	0.0		16	80.0	6	30.0	3	15.0				
Unable	8	40.0	0	0.0	0	0.0		2	10.0	2	10.0	0	0.0				
2.Write																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	2	10.0	9	45.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	14	70.0	5	25.0	33.522* (<0.001*)	0	0.0	12	60.0	14	70.0	26.909* (<0.001*)	1.905 (0.168)	3.802 (^{MC}p=0.271)	21.575* (^{MC}p<0.001*)
Severe Difficulty	12	60.0	2	10.0	0	0.0		16	80.0	6	30.0	4	20.0				
Unable	8	40.0	2	10.0	2	10.0		4	20.0	2	10.0	2	10.0				
3.Turn a key																	
No Difficulty	0	0.0	0	0.0	6	30.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	2	10.0	14	70.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	18	90.0	0	0.0	39.077* (<0.001*)	0	0.0	10	50.0	17	85.0	29.158 (<0.001*)	0.229 (^{FE}p=1.00)	14.977* (^{MC}p=0.001*)	45.270* (^{MC}p<0.001*)
Severe Difficulty	17	85.0	0	0.0	0	0.0		18	90.0	10	50.0	3	15.0				
Unable	3	15.0	0	0.0	0	0.0		2	10.0	0	0.0	0	0.0				
4.Prepare a meal																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	0	0.0	11	55.0		0	0.0	0	0.0	2	10.0				
Moderate Difficulty	0	0.0	20	100.0	5	25.0	38.000* (<0.001*)	0	0.0	10	50.0	15	75.0	26.528* (<0.001*)	3.243 (^{FE}p=0.231)	13.333* (<0.001*)	17.576* (^{MC}p<0.001*)
Severe Difficulty	17	85.0	0	0.0	0	0.0		20	100.0	10	50.0	3	15.0				
Unable	3	15.0	0	0.0	0	0.0		0	0.0	0	0.0	0	0.0				
5.Push open a heavy door																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	0	0.0	6	30.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	16	80.0	8	40.0	37.333* (<0.001*)	0	0.0	8	40.0	13	65.0	23.333* (<0.001*)	0.114 (0.736)	7.610* (^{MC}p=0.022*)	14.911* (^{MC}p=0.001*)
Severe Difficulty	13	65.0	4	20.0	2	10.0		14	70.0	8	40.0	3	15.0				
Unable	7	35.0	0	0.0	0	0.0		6	30.0	4	20.0	4	20.0				
6.Place an object on shelf above your head																	
No Difficulty	0	0.0	0	0.0	6	30.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	2	10.0	6	30.0	7	35.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	10	50.0	5	25.0	34.060* (<0.001*)	0	0.0	8	40.0	10	50.0	26.000* (<0.001*)	2.092 (^{MC}p=0.442)	10.428* (^{MC}p=0.009*)	20.308* (^{MC}p=0.001*)
Severe Difficulty	11	55.0	4	20.0	2	10.0		14	70.0	10	50.0	10	50.0				
Unable	7	35.0	0	0.0	0	0.0		6	30.0	2	10.0	0	0.0				
7.Do heavy household chores (e.g., wash walls ,wash floors)																	
No Difficulty	0	0.0	0	0.0	2	10.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	2	10.0	8	40.0		0	0.0	0	0.0	2	10.0				
Moderate Difficulty	0	0.0	6	30.0	3	15.0	37.507* (<0.001*)	0	0.0	8	40.0	8	40.0	20.421* (<0.001*)	15.0* (<0.001*)	1.939 (^{MC}p=0.523)	7.830 (^{MC}p=0.034*)
Severe Difficulty	6	30.0	12	60.0	7	35.0		18	90.0	12	60.0	10	50.0				
Unable	14	70.0	0	0.0	0	0.0		2	10.0	0	0.0	0	0.0				

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **Fr**: **Friedman test** p3: p value for comparing between the two studied groups in one month after

p_0: p value for comparing between the studied periods in each group

p_1: p value for comparing between the **two** studied groups in **before**

p_2: p value for comparing between the **two** studied groups in **14day after** ***: Statistically significant at p ≤ 0.05**

Table (5): Comparison between the two studied groups according to the disabilities of the arm, shoulder and hand items before and after rehabilitation program implementation

"continue"

DASH	Study(n = 20)							Control(n = 20)								
	Before		14day after		one month after		Fr (p_0)	Before		14day after		one month after		Fr (p_0)	χ^2 (p_1)	χ^2 (p_2)	χ^2 (p_3)
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%				
8.Garden or do yard work																	
Mild Difficulty	0	0.0	0	0.0	10	50.0		0	0.0	0	0.0	2	10.0				
Moderate Difficulty	0	0.0	10	50.0	5	25.0	38.000*	0	0.0	8	40.0	12	60.0	25.120*	10.989*	1.879	8.307*
Severe Difficulty	8	40.0	10	50.0	5	25.0	(<0.001*)	18	90.0	10	50.0	6	30.0	(<0.001*)	(0.001*)	(MCp=0.542)	(0.016*)
Unable	12	60.0	0	0.0	0	0.0		2	10.0	2	10.0	0	0.0				
9.Make a bed																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	4	20.0	9	45.0	39.077*	0	0.0	0	0.0	2	10.0	32.868*	7.619*	12.147*	13.505*
Moderate Difficulty	0	0.0	9	45.0	7	35.0	(<0.001*)	0	0.0	17	85.0	15	75.0	(<0.001*)	(0.006*)	(MCp=0.002*)	(MCp=0.001*)
Severe Difficulty	10	50.0	7	35.0	0	0.0		18	90.0	1	5.0	1	5.0				
Unable	10	50.0	0	0.0	0	0.0		2	10.0	2	10.0	2	10.0				
10.Carry a shopping bag or briefcase																	
Mild Difficulty	0	0.0	0	0.0	13	65.0		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	16	80.0	7	35.0	38.675*	0	0.0	11	55.0	14	70.0	34.900*	3.636	2.849	23.356*
Severe Difficulty	8	40.0	4	20.0	0	0.0	(<0.001*)	14	70.0	9	45.0	6	30.0	(<0.001*)	(0.057)	(0.091)	(MCp<0.001*)
Unable	12	60.0	0	0.0	0	0.0		6	30.0	0	0.0	0	0.0				
11.Carry a heavy object (over 10 Ibs)																	
Mild Difficulty	0	0.0	0	0.0	10	50.		0	0.0	0	0.0	0	0.0				
Moderate Difficulty	0	0.0	8	40.0	4	20.0	37.730*	0	0.0	8	40.0	13	65.0	26.941*	6.400*	1.843	17.585*
Severe Difficulty	6	30.0	12	60.0	6	30.0	(<0.001*)	14	70.0	10	50.0	5	25.0	(<0.001*)	(0.011*)	(MCp=0.657)	(MCp<0.001*)
Unable	14	70.0	0	0.0	0	0.0		6	30.0	2	10.0	2	10.0				
12.Change a light bulb overhead																	
No Difficulty	0	0.0	0	0.0	2	10.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	2	10.0	8	40.0	39.077*	0	0.0	0	0.0	0	0.0	29.059*	3.956*	1.879	14.005*
Moderate Difficulty	0	0.0	8	40.0	8	40.0	(<0.001*)	0	0.0	10	50.0	13	65.0	(<0.001*)	(0.047*)	(MCp=0.534)	(MCp=0.001*)
Severe Difficulty	10	50.0	10	50.0	2	10.0		16	80.0	10	50.0	7	35.0				
Unable	10	50.0	0	0.0	0	0.0		4	20.0	0	0.0	0	0.0				
13.Wash or blows dry your hair																	
No Difficulty	0	0.0	0	0.0	4	20.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	0	0.0	9	45.0	35.521*	0	0.0	0	0.0	4	20.0	26.462*	0.960	0.902(0.342)	9.071*
Moderate Difficulty	0	0.0	11	55.0	5	25.0	(<0.001*)	0	0.0	8	40.0	10	50.0	(<0.001*)	(0.327)		(MCp=0.022*)
Severe Difficulty	11	55.0	9	45.0	2	10.0		14	70.0	12	60.0	6	30.0				
Unable	9	45.0	0	0.0	0	0.0		6	30.0	0	0.0	0	0.0				
14.Wash your back																	
No Difficulty	0	0.0	0	0.0	2	10.0		0	0.0	0	0.0	0	0.0				
Mild Difficulty	0	0.0	2	10.0	11	55.0	38.519*	0	0.0	0	0.0	2	10.0	24.174*	0.960	6.717*	19.112*
Moderate Difficulty	0	0.0	12	60.0	7	35.0	(<0.001*)	0	0.0	6	30.0	8	40.0	(<0.001*)	(0.327)	(MCp=0.040*)	(MCp=0.001*)
Severe Difficulty	11	55.0	6	30.0	0	0.0		14	70.0	14	70.0	10	50.0				
Unable	9	45.0	0	0.0	0	0.0		6	30.0	0	0.0	0	0.0				

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **Fr**: **Friedman test**

p_0: p value for comparing between the studied periods in each group

p_1: p value for comparing between the **two** studied groups in **before**

p_2: p value for comparing between the **two** studied groups in **14day after p3: p value for comparing between the two studied groups in one month after** ***: Statistically significant at p ≤ 0.05**

Table (5): Comparison between the two studied groups according to the disabilities of the arm, shoulder and hand items before and after rehabilitation program implementation- "continue"

DASH	Study(n = 20) Before	14day after	one month after	Fr (p_0)	Control(n = 20) Before	14day after	one month after	Fr (p_0)	χ^2 (p_1)	χ^2 (p_2)	χ^2 (p_3)
	No. %	No. %	No. %		No. %	No. %	No. %				
15.Put on a pullover sweater											
No Difficulty	0 0.0	0 0.0	4 20.0		0 0.0	0 0.0	0 0.0				
Mild Difficulty	0 0.0	2 10.0	11 55.0	38.675*	0 0.0	0 0.0	2 10.0	26.000*	0.143	8.298*	18.883*
Moderate Difficulty	0 0.0	16 80.0	5 25.0	(<0.001*)	0 0.0	10 50.0	12 60.0	(<0.001*)	(FEp=1.000)	(MCp=0.008*)	(MCp<0.001*)
Severe Difficulty	15 75.0	2 10.0	0 0.0		16 80.0	10 50.0	6 30.0				
Unable	5 25.0	0 0.0	0 0.0		4 20.0	0 0.0	0 0.0				
16.Use a knife to cut food											
No Difficulty	0 0.0	0 0.0	6 30.0		0 0.0	0 0.0	0 0.0				
Mild Difficulty	0 0.0	2 10.0	4 20.0	38.675*	0 0.0	0 0.0	2 10.0	31.714*	0.114	3.408	10.316*
Moderate Difficulty	0 0.0	11 55.0	10 50.0	(<0.001*)	0 0.0	10 50.0	15 75.0	(<0.001*)	(0.736)	(MCp=0.408)	(MCp=0.008*)
Severe Difficulty	13 65.0	7 35.0	0 0.0		14 70.0	8 40.0	3 15.0				
Unable	7 35.0	0 0.0	0 0.0		6 30.0	2 10.0	0 0.0				
17.Recreational activities which require little effort (e.g., card playing knitting etc)											
Mild Difficulty	0 0.0	0 0.0	11 55.0		0 0.0	0 0.0	0 0.0				
Moderate Difficulty	0 0.0	14 70.0	9 45.0	36.685*	0 0.0	10 50.0	15 75.0	27.246*	0.533	2.581	18.732*
Severe Difficulty	16 80.0	6 30.0	0 0.0	(<0.001*)	14 70.0	8 40.0	5 25.0	(<0.001*)	(0.465)	(MCp=0.294)	(MCp<0.001*)
Unable	4 20.0	2 10.0	0 0.0		6 30.0	2 10.0	0 0.0				
18.Recreational activities in which you take some force or impact through your arm ,shoulder or hand (e.g., golf hammering tennis etc)											
Mild Difficulty	0 0.0	0 0.0	4 20.0		0 0.0	0 0.0	0 0.0				
Moderate Difficulty	0 0.0	8 40.0	11 55.0	37.211*	0 0.0	6 30.0	15 75.0	28.526*	0.440	4.194	6.445
Severe Difficulty	6 30.0	12 60.0	5 25.0	(<0.001*)	8 40.0	10 50.0	3 15.0	(<0.001*)	(0.507)	(MCp=0.166)	(MCp=0.071)
Unable	14 70.0	0 0.0	0 0.0		12 60.0	4 20.0	2 10.0				
19.Recreational activities in which you move your arm freely (e.g. , playing Frisbee , badminton etc)											
Mild Difficulty	0 0.0	0 0.0	8 40.0		0 0.0	0 0.0	0 0.0				
Moderate Difficulty	0 0.0	8 40.0	9 45.0	33.091*	0 0.0	6 30.0	12 60.0	24.500*	0.404	0.562	15.320*
Severe Difficulty	8 40.0	9 45.0	0 0.0	(<0.001*)	10 50.0	10 50.0	6 30.0	(<0.001*)	(0.525)	(MCp=0.839)	(MCp<0.001*)
Unable	12 60.0	3 15.0	3 15.0		10 50.0	4 20.0	2 10.0				
20. Manage transportation needs (getting from one place to another)											
No Difficulty	0 0.0	0 0.0	4 20.0		0 0.0	0 0.0	0 0.0				
Mild Difficulty	0 0.0	4 20.0	7 35.0	35.521*	0 0.0	0 0.0	8 40.0	29.525*	2.105	4.224	6.427
Moderate Difficulty	0 0.0	9 45.0	9 45.0	(<0.001*)	0 0.0	12 60.0	9 45.0	(<0.001*)	(FEp=0.487)	(MCp=0.174)	(MCp=0.077)
Severe Difficulty	18 90.0	7 35.0	0 0.0		20 100.0	8 40.0	3 15.0				
Unable	2 10.0	0 0.0	0 0.0		0 0.0	0 0.0	0 0.0				
21. Sexual activities											
No Difficulty	0 0.0	0 0.0	5 25.0		0 0.0	0 0.0	0 0.0				
Mild Difficulty	0 0.0	7 35.0	10 50.0	36.028*	0 0.0	4 20.0	12 60.0	29.525*	7.952*	4.892(0.087)	7.713
Moderate Difficulty	5 25.0	11 55.0	5 25.0	(<0.001*)	0 0.0	8 40.0	5 25.0	(<0.001*)	(MCp=0.009*)		(MCp=0.036*)
Severe Difficulty	13 65.0	2 10.0	0 0.0		20 100.0	8 40.0	3 15.0				
Unable	2 10.0	0 0.0	0 0.0		0 0.0	0 0.0	0 0.0				

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **Fr**: **Friedman test** *:Statistically significant at $p \leq 0.05$

p_0: p value for comparing between the studied periods in each group- p_1: p value for comparing between the **two** studied groups in **before**

p_2: p value for comparing between the **two** studied groups in **14day after -** p_3: p value for comparing between the **two** studied groups in **one month after**

Table (6): Comparison between the two studied groups according to the disabilities of the arm, shoulder and hand before and after rehabilitation program implementation. (n=40)

DASH	Study(n = 20) Before	14day after	One month after	Test of sig. (p_0)	Control(n = 20) Before	14day after	One month after	Test of sig. (p_0)	Test of sig. χ^2 (p_1)	Test of sig. χ^2 (p_2)	Test of sig. χ^2 (p_3)
	No. %	No. %	No. %		No. %	No. %	No. %				
Minimal <50%	0 0.0	2 10.0	15 75.0		0 0.0	4 20.0	8 40.0				
Mild 50 - <65	0 0.0	12 60.0	5 25.0	Fr=38.079*	0 0.0	4 20.0	9 45.0	Fr=34.088*	χ^2=0.00	χ^2=7.197	χ^2=5.802*
Moderate 65 - <85	11 55.0	6 30.0	0 0.0	(<0.001*)	11 55.0	10 50.0	3 15.0	(<0.001*)	(1.000)	(MCp=0.058)	(MCp=0.035*)
Severe ≥85	9 45.0	0 0.0	0 0.0		9 45.0	2 10.0	0 0.0				
Total score	92.15 ± 6.98	68.10 ± 8.23	49.50 ± 13.49	F=322.921*	88.40 ± 5.20	74.90 ± 10.59	33.93 ± 16.06	F= 76.285*	t= 1.928	t=2.267*	t=4.926*
Percent Score	84.70 ± 8.30	56.07 ± 9.80	67.60 ± 9.38	(<0.001*)	80.24 ± 6.18	64.17 ± 12.61	55.48 ±11.17	(<0.001*)	(0.061)	(0.029*)	(<0.001*)

χ^2: **Chi square test** MC: **Monte Carlo** **t: Student t-test** **Fr**: **Friedman test** **F: F test (ANOVA) with repeated measures**

p_0: p value for comparing between the studied periods in each group - p_1: p value for comparing between the **two** studied groups in **before**

p_2: p value for comparing between the **two** studied groups in **14day after -** p_3: p value for comparing between the **two** studied groups in **one month after**

*: Statistically significant at $p \leq 0.05$

Table (7): Comparison between the two studied groups according to Boston carpal tunnel items before and after rehabilitation program implementation (n=40)

CTSQ	Study(n = 20) Before		14day after		one month after		Test of sig. (p_0)	Control(n = 20) Before		14day after		one month after		Test of sig. (p_0)	χ^2 (p_1)	χ^2 (p_2)	χ^2 (p_3)
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%				
1. How severe is the hand or wrist pain that you have at night?																	
None or Never	0	0.0	0	0.0	9	45.0		0	0.0	0	0.0	0	0.0				
Mild	0	0.0	2	10.0	6	30.0	Fr=39.077*	0	0.0	0	0.0	0	0.0	Fr=36.033*	5.013*	5.912*	26.953*
Moderate	0	0.0	13	65.0	5	25.0	(<0.001*)	0	0.0	8	40.0	12	60.0	(<0.001*)	(0.025*)	(MCp=0.044*)	(MCp<0.001*)
Severe	15	75.0	5	25.0	0	0.0		8	40.0	11	55.0	7	35.0				
Very Severe	5	25.0	0	0.0	0	0.0		12	60.0	1	5.0	1	5.0				
2. How often did hand or wrist pain wake you up during a typical night in the past two weeks? (times/day)																	
Min. – Max.	4.0 – 4.0		2.0 – 3.0		1.0 – 3.0		F=301.00*	4.0 – 6.0		3.0 – 5.0		2.0 – 4.0		F=78.021*	t=4.067*	t=4.160*	t=5.596*
Mean ± SD.	4.0 ± 0.0		2.90 ± 0.31		2.0 ± 0.46		(<0.001*)	4.55 ± 0.60		3.65 ± 0.75		2.95 ± 0.60		(<0.001*)	(0.001*)	(<0.001*)	(<0.001*)
3. Do you typically have pain in your hand or wrist during the daytime?																	
None or Never	2	10.0	2	10.0	14	70.0	Fr=34.353*	12	60.0	12	60.0	12	60.0	Fr=16.000*	11.536*	12.596*	7.358*
Severe	16	80.0	4	20.0	4	20.0	(<0.001*)	8	40.0	0	0.0	0	0.0	(<0.001*)	(MCp=0.003*)	(MCp=0.001*)	(MCp=0.024*)
Very Severe	2	10.0	14	70.0	2	10.0		0	0.0	8	40.0	8	40.0				
4. How often do you have hand or wrist pain during the daytime? (times/day)																	
Min. – Max.	3.0 – 4.0		1.0 – 3.0		1.0 – 2.0		F=260.78*	3.0 – 6.0		2.0 – 6.0		1.0 – 5.0		F=103.58*	t=3.946*	t=4.766*	t=4.781*
Mean ± SD.	3.20 ± 0.41		1.85 ± 0.75		1.20 ± 0.41		(<0.001*)	4.20 ± 1.06		3.50 ± 1.36		2.70 ± 1.34		(<0.001*)	(0.001*)	(<0.001*)	(<0.001*)
5. How long, on average, does an episode of pain last during the daytime (minutes)? (minutes)																	
Min. – Max.	6.0 – 60.0		30.0 – 30.0		10.0 – 15.0		F=27.270*	60.0 – 90.0		30.0 – 60.0		30.0 – 30.0		F=95.521*	t=3.641*	t=5.107*	t=35.194*
Mean ± SD.	43.2± 22.5		30.0 ± 0.0		11.5 ± 2.35		(<0.001*)	63.0 ± 9.23		43.5±11.82		30.0 ± 0.0		(<0.001*)	(0.001*)	(<0.001*)	(<0.001*)
6.Do you have numbness (loss of sensation) in your hand?																	
No	0	0.0	0	0.0	20	100.0	Fr=40.000*	0	0.0	0	0.0	12	60.0	Fr=24.000*	–	–	10.00*
Yes	20	100.0	20	100.0	0	0.0	(<0.001*)	20	100.0	20	100.0	8	40.0	(<0.001*)			(MCp=0.003*)
7.Do you have weakness in your hand or wrist?																	
No	0	0.0	5	25.0	20	100.0	Fr=32.500*	3	15.0	3	15.0	8	40.0	Fr=10.000*	3.243	0.625	17.143*
Yes	20	100.0	15	75.0	0	0.0	(<0.001*)	17	85.0	17	85.0	12	60.0	(0.007*)	(FEp=0.231)	(FEp=0.695)	(<0.001*)
8. Do you have tingling sensations in your hand or wrist?																	
No	0	0.0	0	0.0	20	100.0	Fr=40.000*	0	0.0	0	0.0	2	10.0	Fr=4.000	–	–	32.727*
Yes	20	100.0	20	100.0	0	0.0	(<0.001*)	20	100.0	20	100.0	18	90.0	(0.135)			(<0.001*)
9.How severe is numbness (loss of sensation) or tingling at night?																	
None or Never	0	0.0	0	0.0	7	35.0		0	0.0	0	0.0	0	0.0				
Mild	3	15.0	3	15.0	11	55.0	Fr=38.675*	0	0.0	0	0.0	6	30.0	Fr=34.000*	5.494	11.891*	19.184*
Moderate	0	0.0	15	75.0	2	10.0	(<0.001*)	0	0.0	8	40.0	6	30.0	(<0.001*)	(MCp=0.055)	(MCp=0.003*)	(MCp<0.001*)
Severe	13	65.0	2	10.0	0	0.0		10	50.0	8	40.0	8	40.0				
Very Severe	4	20.0	0	0.0	0	0.0		10	50.0	4	20.0	0	0.0				
10How often did hand numbness or tingling wake you up during a typical night in the last two weeks?																	
Min. – Max.	3.0 – 5.0		2.0 – 3.0		1.0 – 2.0		Fr=15.200*	4.0 – 6.0		3.0 – 6.0		3.0 – 5.0		Fr=19.000*	t=2.971*	t=5.895*	t=10.274*
Mean ± SD.	4.05 ± 0.51		2.40 ± 0.50		1.30 ± 0.47		(0.001*)	4.65 ± 0.75		3.90 ± 1.02		3.30 ± 0.73		(<0.001*)	(0.005*)	(<0.001*)	(<0.001*)
11. Do you have any difficulty with the grasping and use of small objects such as keys or pens?																	
None or Never	12	60.0	12	60.0	16	80.0		10	50.0	10	50.0	10	50.0				
Mild	0	0.0	2	10.0	4	20.0	F=197.65*	0	0.0	0	0.0	2	10.0	F=79.626*	0.404(0.525)	2.792	10.568*
Moderate	0	0.0	6	30.0	0	0.0	(<0.001*)	0	0.0	10	50.0	8	40.0	(<0.001*)		(MCp=0.227)	(MCp=0.006*)
Severe	8	40.0	0	0.0	0	0.0		10	50.0	0	0.0	0	0.0				

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **t: Student t-test** **Fr**: **Friedman test**
F: F test (ANOVA) with repeated measures
p_0: p value for comparing between the studied periods in each group
p_1: p value for comparing between the **two** studied groups in **before**
p_2: p value for comparing between the **two** studied groups in **14day after**
p_3: p value for comparing between the **two** studied groups in **one month after** *: Statistically significant at $p \leq 0.05$

Table (8): Comparison between the two studied groups according to the disabilities of the arm, shoulder and hand and Boston carpal tunnel items (n=40)

CTSO	Study(n = 20) Before		14day after		One month after		Test of sig. (p_0)	Control(n = 20) Before		14day after		One month after		Test of sig. (p_0)	Test of sig. χ^2 (p_1)	Test of sig. χ^2 (p_2)	Test of sig. χ^2 (p_3)
	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%				
Low <50	12	60.0	20	100.0	20	100.0		18	90.0	20	100.0	20	100.0				
Moderate 50 - <75	8	40.0	0	0.0	0	0.0	Fr=16.000* (<0.001*)	2	10.0	0	0.0	0	0.0	Fr= 4.000 (0.135)	χ^2=4.800* (0.028*)	–	–
High ≥75	0	0.0	0	0.0	0	0.0		0	0.0	0	0.0	0	0.0				
Total score	31.0 ± 2.45		21.30 ± 1.84		13.35 ± 1.87		F=670.492* (<0.001*)	31.60 ± 0.68		26.25 ± 1.45		22.10 ± 1.52		F=307.651* (<0.001*)	t= 1.055 (0.303)	t= 9.464* (<0.001*)	t= 16.237* (<0.001*)
Percent Score	45.45 ± 5.57		23.41 ± 4.18		5.34 ± 4.25			46.82 ± 1.55		34.66 ± 3.29		25.23 ± 3.45					

χ^2: **Chi square test** MC: **Monte Carlo** FE**: Fisher Exact** **t: Student t-test** **Fr**: **Friedman test**
F: F test (ANOVA) with repeated measures - p_0: p value for comparing between the studied periods in each group
p_1: p value for comparing between the **two** studied groups in **before** - p_2: p value for comparing between the **two** studied groups in **14day after**
p_3: p value for comparing between the **two** studied groups in **one month after** - *: Statistically significant at $p \leq 0.05$

Table (9) Relation between the disabilities of the arm, shoulder and hand with age and occupation in study group .(n = 20)

	DASH Before				14day after				One month after			
	Moderate (n=11)		Severe (n=9)		Minimal (n=2)		Mild (n=12)		Moderate (n=6)		Minimal (n=15)		Mild (n=5)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Age														
30 – < 40	9	81.8	3	33.3	2	100.0	8	66.7	2	33.3	12	80.0	0	0.0
40 – < 60	1	9.1	4	44.4	0	0.0	3	25.0	2	33.3	3	20.0	2	40.0
50 – 59	1	9.1	2	22.2	0	0.0	1	8.3	2	33.3	0	0.0	3	60.0
χ^2(^{MC}p)	4.779(0.086)				3.646(0.476)				12.168*(<0.001*)					
Occupation														
Clerical	5	45.5	7	77.8	0	0.0	8	66.7	4	66.7	9	60.0	3	60.0
Farmer	1	9.1	1	11.1	0	0.0	0	0.0	2	33.3	0	0.0	2	40.0
House wife	4	36.4	1	11.1	2	100.0	3	25.0	0	0.0	5	33.3	0	0.0
Others (secretory)	1	9.1	0	0.0	0	0.0	1	8.3	0	0.0	1	6.7	0	0.0
χ^2(^{MC}p)	2.992(0.470)				10.579*(0.037*)				6.227*(0.044*)					

χ^2: **Chi square test** MC: **Monte Carlo** p: p value for association between different categories - *: Statistically significant at $p \leq 0.05$

Table (10)Relation between with age and occupation in study group (n = 20)

	CTSO Before				14day after		One month after	
	Low (n=12)		Moderate (n=8)		Low (n=20)		Low (n=20)	
	No.	%	No.	%	No.	%	No.	%
Age								
30 – < 40	4	33.3	8	100.0	12	60.0	12	60.0
40 – < 60	5	41.7	0	0.0	5	25.0	5	25.0
50 – 59	3	25.0	0	0.0	3	15.0	3	15.0
χ^2(^{MC}p)	8.060*(0.008*)				–		–	
Occupation								
Clerical	10	83.3	2	25.0	12	60.0	12	60.0
Farmer	2	16.7	0	0.0	2	10.0	2	10.0
House wife	0	0.0	5	62.5	5	25.0	5	25.0
Others (secretory)	0	0.0	1	12.5	1	5.0	1	5.0
χ^2(^{MC}p)	12.084*(0.001*)				–		–	

χ^2: **Chi square test** MC: **Monte Carlo** p: p value for association between different categories - *: Statistically significant at $p \leq 0.05$

Discussion

Carpal tunnel syndrome is a leading cause of musculoskeletal upper extremity conditions, which are among the most severe and expensive health issues in the world's working population. **Nambiema etal (2020)** who studied "Proportion of upper extremity musculoskeletal disorders attributable to personal and occupational factors" . **Uchiyama etal (2010)** who studied "Current concepts of carpal tunnel syndrome pathophysiology treatment, and evaluation " reported that carpal tunnel syndrome affect the life of a patient badly as the hand is the most important tool which one uses for daily activities. Housewives and computer operators are badly affected. The continuous agonizing pain leads to the poor functional outcome related to CTS.

Shin (2019) who studied " Endoscopic Versus Open Carpal Tunnel Release" illustrated that among the available treatments for CTS, surgical release of the tunnel through an open or endoscopic approach is the most common choice. **Turner etal (2010)** who studied " Can the outcome of open carpal tunnel release be predicted " who reported surgery is a safe and successful method in nerve conduction studies for patients with signs and symptoms of carpal tunnel syndrome who have severe compression. To decrease chronic pain and restore function, surgical intervention is necessary. Although carpal tunnel surgery may improve long-term results for these patients, patients can experience swelling after surgery, stiffness and weakness. At this time, physical therapy rehabilitation will help patients heal more quickly and increase the likelihood of achieving pain-free optimal function in day to day activities., post-surgical rehabilitation greatly increases the success of surgical intervention.

As regard patients' sociodemodraphic data and clinical data ,the results of the present study revealed that more than half of study and control groups were females . More than half of study and control groups were aged from 40-60 years old., the majority of the studied patients in the study group and all subjects in control group were married and half of the study (50 %) were university graduates .This study was supported by **Genova etal (2020)** who studied "Carpal tunnel syndrome" who reported that the annual prevalence percentage of CTS is estimated to be 3.8% in the general population and it can occur in all ages . However, now 40 to 60 years old is the most common age of this disease. It is estimated that 9% of female and 6% of male affected by this syndrome in their life . Also these results in line with **Ibrahim etal (2012)** who studied "Carpal tunnel syndrome " who reported that women are three times more likely to develop the condition than men because they have a narrower carpal tunnel space. Swelling is also associated with the temporary fluid retention that occurs during pregnancy.

The study showed that in this context, more than half of the study patients had diabetes mellitus **Pourmemari and Shiri (2016)** who studied "Effectiveness of occupational therapy interventions for adults with musculoskeletal conditions of the forearm, wrist, and hand" reported that high levels of blood glucose would lead to problems with the carpal tunnel. As blood sugar increases, glucose binds to proteins in the carpal tunnel tendons that become inflamed and the tendons are unable to slide freely.In the present study, there was no significant statistical difference between age, gender, marital status, educational level,occupation, medical history, duration of symptoms in two groups, which show that these factors do not affect the present study results. There was no statistical difference in pain, symptoms and functional status preoperatively .

The present study revealed that the majority of the study and control group that developed CTS holded hand in one position repetitively ,had rapid “trigger” finger movements , pressing with their hands repetitively , had frequent wrist flexion and extension. In this regard **Unver and Akyolcu (2018)** in line with the current study who reported in his study entitled "The effect of hand exercise on reducing the symptoms in hemodialysis patients with carpal tunnel syndrome" who reported that the median nerve undergoes acute changes in response to repeated manual jobs,

Also ,the present study supported with study conducted with **Blevin (2020)** who studied " Nurses as Educators. Carpal Tunnel Syndrome" who reported the prevalence of CTS was reported higher in employees who perform extremely repetitive manual jobs, which is further evidence of a potential causal association between repetitive manual jobs and median nerve injuries .

This study revealed that there were statistical significant differences between the two groups subjects regarding pain severity in the follow up periods postoperatively . In this context, tendon and nerve gliding exercises have been reported to result in a substantial reduction in pain in CTS patients **Roll and Hardison (2017) who studied** "Effectiveness of occupational therapy interventions for adults with musculoskeletal conditions of the forearm, wrist, and hand: a

systematic review". Another research by **Salehi etal (2019)** who studied " The Effectiveness of Exercise Therapy and Dry Needling on Wrist Range of Motion, Pinch and Grip Force in Carpal Tunnel Syndrome" also found that stretching exercises and mobilization in CTS patients had a major impact on reducing pain. The results of a study supported by **BallesteroPerez (2017)** who studied "Effectiveness of nerve gliding exercises on carpal tunnel syndrome) who reported that exercises of the wrist for three weeks results in significant improvement in CTS symptoms and decreasing pain , also the present study in line with **Hamzeh.,etal (2020**who studied "The long-term effect of neurodynamics vs exercise therapy on pain and function in people with carpal tunnel syndrome" who reported that there were statistically significant difference on pain severity was found before and after performing the exercise because the physical modalities in the form of exercise that are used to stimulate the muscle proprioceptors and reduce the stress on nerves, are effective on reducing pain .

The results of the present study showed that there were significant differences between the study and control groups and significant improvement for the study post operatively in relation to DASH. In this respect, it was found that nerve and tendon gliding exercises were important in reducing the severity of symptoms and improving hand function in patients with CTS .**Akalın et al (2002)** who studied " treatment of carpal tunnel syndrome with nerve and tendon gliding exercises ". In this regard the study's results are justified by **Bobowik (2019)** who studied **"**Effectiveness of physiotherapy in carpal tunnel syndrome . Advances in Rehabilitation" who reported that postoperative exercises can be used in CTS for median nerve neural mobilization and improvement of upper limb muscle tendons in CTS. The results of **Laspenas etal (2017)** who studied "The effectiveness of manual therapy versus surgery on self-reported function, cervical range of motion, and pinch grip force in carpal tunnel syndrome " reported in their findings of a study that exercise therapy is successful in improving the severity of symptoms and the performance of outcomes for CTS patients.

It a substantial difference between the study and control groups was observed over the post-operative follow-up period in relation to the severity of the symptoms, justified by of **Unver and Akyolcu (2018)** who studied " The effect of hand exercise on reducing the symptoms in hemodialysis patients with carpal tunnel syndrome" who stated that nerve and tendon gliding exercises can overcome symptoms by stretching the adhesions in the carpal canal, promoting venous return from the nerve bundles,, and reducing pressure inside the carpal tunnel .

Regarding disabilities of the arm, shoulder and hand, the results of the present study showed that majority of patients in the control and the study groups had shoulder,arm and hand disability preoperatively and then improved after performing the exercise .In this context **Zidkova etal (2019)** who studied "Effects of Exercise and Enzyme Therapy in Early Occupational Carpal Tunnel Syndrome: A Preliminary Study" who reported that significant positive effect of specific exercise techniques on CTS manifestations was achieved , this finding is also confirmed by **Rafn etal (2018)** who studied "Prospective surveillance and targeted physiotherapy for arm morbidity after surgery"who reported that early participation in post-operative exercise program seemed to have a positive impact on the range of motion of the shoulder, muscle strength and improvement of arm functional capability ,also **Fragala etal (2019)** who studied "Resistance training for older adults: position statement from the national strength and conditioning association" mentioned that he early start of exercise is successful in terms of recovery of daily living activities and provides improvement in shoulder movement and disability prevention.

This result presented that the majority of the study group and some of control group had lower disabilities at one month. However, the improvement was higher among the study group after performing the exercises than in control group. This result is in agreement with **Blanquero., et.al (2020)**who studied "Proportion of upper extremity musculoskeletal disorders attributable to personal and occupational factors" who concluded that physiotherapy was shown to be safe and effective in improving shoulder function without major complications in the form of exercises. This could be due to the study patients' commitment to the exercise program and patients have been strongly advised to perform daily living activities such as bathing, dressing, ambulation and preparing meals independently which is considered part of rehabilitation movement to improve functional ability.

The findings of the present study were consistent with **Zwolinska (2019)** who studied "Factors determining the effectiveness of conservative treatment in patients with carpal tunnel syndrome" who reported that immediately after completion of the rehabilitation and exercise program, there were substantial improvements in the quality of sensation, range of motion at the wrist, and hand muscle strength. **Ballestero (2017)** who studied "Effectiveness of nerve gliding exercises

on carpal tunnel syndrome" concluded that exercise after surgery to stop nerve scarring. Range of exercises in motion. The range of motion exercise may help to heal significant wrist trauma. By stretching the adhesions in the carpal canal, improving venous return from the nerve bundles, and reducing pressure inside the carpal tunnel, nerve and tendon gliding exercises can resolve symptoms. **Unver and Akyolcu (2018)** who studied "The effect of hand exercise on reducing the symptoms in hemodialysis patients with carpal tunnel syndrome".

The results of the current study in line with **Bobowik (2019)** who studied "Effectiveness of physiotherapy in carpal tunnel syndrome (CTS). Advances in Rehabilitation" who reported that after performing postoperative exercises, the symptom intensity scale, functional status scale were improved , and rapid DASH ranking was present . Another study by **Marryam etaL (2018)** who studied "A comparision of the effectiveness of neurodynamics versus nerve and tendon gliding exercises alone for carpal tunnel syndrome"reported that effectiveness of nerve and tendon gliding exercises revealed that that group which received nerve and tendon gliding exercises ,also reported a reduction in the severity of the symptoms on the same scale.

The present study showed that there were positive correlation between the CTS and the occupation , this results supported by **Graveling (2018**) who studied " Application of the approach. Ergonomics and Musculoskeletal Disorders (msds) in the Workplace" who reported that there was increasing scientific evidence that development of CTS is promoted by highly repetitive manual tasks, involving the hand and the wrist postures, with flexion and extension of the hands, forceful exertion or hand and the arm vibration during work .Some occupational groups are more exposed than others, due to the nature of their work. These are mostly occupations that involve the regular use of handheld vibratory instruments and high physical exposure levels, particularly during assembly, food processing and packaging work. .

Finally, the exercises that help the median nerve move more freely within the carpal tunnel. In addition, exercises to help tendons glide through the carpal tunnel can help improve joint range of motion and hand function.

Conclusion

Based on the findings of the present study, it can be concluded that application of the nursing rehabilitation program had significant effect in decreasing the CTS symptoms, and improvement in functional status of patients ,also decreasing disabilities of the arm, shoulder, and hand also decreased pain intensity .

Recommendations

Based on the finding of the present study, the following recommendations are

A-Recommendations for patients:

- The developed booklet should be available and distributed to all patients with carpal tunnel syndrome in the study setting, and outpatient clinics.

- The developed educational program should be given to all patients with carpal tunnel syndrome

B-Recommendations for nurses

- Encourage nurses to attend conferences, workshops about management of patients with carpal tunnel syndrome
- Implementation of the educational program should be performed by nurses for patients with carpal tunnel syndrome before and after the operation, as well as during the recovery period

References

Akalin, E., El, O., Peker, O., Senocak, O., Tamci, S., Gülbahar, S., ... & Oncel, S. (2002). Treatment of carpal tunnel syndrome with nerve and tendon gliding exercises. American journal of physical medicine & rehabilitation, 81(2), 108-113.

Alanazy, M. H., Alaboudi, M., Almaari, A., Alhumayyd, Z., Albulaihe, H., & Muayqil, T. (2019). Translation and validation of the Arabic version of the Boston carpal tunnel syndrome questionnaire. Neurosciences (Riyadh, Saudi Arabia), 24(4), 296–301. https://doi.org/10.17712/nsj.2019.4.20190014

Amir, S., Qadir, M., & Usman, M. (2018). CLINICAL PROFILE OF PATIENTS WITH CARPAL TUNNEL SYNDROME. Khyber Medical University Journal, 10(1).

Ballestero-Perez, R., Plaza-Manzano, G., Urraca-Gesto, A., Romo-Romo, F., de los Ángeles Atín-Arratibel, M., Pecos-Martín, D., ... & Romero-Franco, N. (2017). Effectiveness of nerve gliding exercises on carpal tunnel syndrome: a systematic review. Journal of manipulative and physiological therapeutics, 40(1), 50-59.

Banschbach, S. K. (2016). Perioperative Nurse Leaders and Their Role in Patient Safety. AORN Journal, 104(2), 161–164. https://doi.org/10.1016/j.aorn.2016.06.011

Bao, S. S., Kapellusch, J. M., Merryweather, A. S., Thiese, M. S., Garg, A., Hegmann, K. T., Silverstein, B. A., Marcum, J. L., & Tang, R. (2016). Impact of Work Organizational Factors on Carpal Tunnel Syndrome and Epicondylitis. Journal of Occupational and Environmental Medicine, 58(8), 760–764. https://doi.org/10.1097/JOM.0000000000000790

Blanquero, J., CortesVega, M. D., Rodriguez-Sanchez-Laulhe, P., Corrales-Serra, B. P., Gómez-Patricio, E., Díaz-Matas, N., & Suero-Pineda, A. (2020). Feedback-guided exercises performed on a tablet touchscreen improve return to work, function, strength and healthcare usage more than an exercise program prescribed on paper for people with wrist, hand or finger injuries: a randomised trial. Journal of Physiotherapy, 66(4), 236-242.

Blevins, S. (2020). Nurses as Educators. Carpal Tunnel Syndrome. Medsurg Nursing, 29(1).

Bobowik, P. Ż. (2019). Effectiveness of physiotherapy in carpal tunnel syndrome (CTS). Advances in Rehabilitation, 33(2), 47-58.

Brazier Y 2018 . Carpal tunnel syndrome

Chiang, C. Liao, C. & Kuo, H.. (2017). Postures of upper extremity correlated with carpal tunnel syndrome (CTS). International journal of occupational medicine and environmental health, 30(2), 281.

Dansie, E. J., & Turk, D. C. (2013). Assessment of patients with chronic pain. British Journal of Anaesthesia, 111(1), 19–25. https://doi.org/10.1093/bja/aet124

Fernandez De-Las-Penas, C., Cleland, J., Palacios-Cea, M., Fuensalida-Novo, S., Pareja, J. A., & Alonso-Blanco, C. (2017). The effectiveness of manual therapy versus surgery on self-reported function, cervical range of motion, and pinch grip force in carpal tunnel syndrome: a randomized clinical trial. Journal of orthopaedic & sports physical therapy, 47(3), 151-161.

Fragala, M.., Cadore, E.., Dorgo, S., Izquierdo, M., Kraemer, J., Peterson, M. & Ryan, D. (2019). Resistance training for older adults: position statement from the national strength and conditioning association. The Journal of Strength & Conditioning Research, 33(8).

Genova, A., Dix, O., Saefan, A., Thakur, M., & Hassan, A. (2020). Carpal Tunnel Syndrome: A Review of Literature. Cureus, 12(3), e7333. Https://doi.org/10.7759/cureus.7333

Genova, A., Dix, O., Saefan, A., Thakur, M., & Hassan, A. (2020). Carpal tunnel syndrome: a review of literature. Cureus, 12(3).

Graveling, R. (2018). Application of the approach. Ergonomics and Musculoskeletal Disorders (msds) in the Workplace: A Forensic and Epidemiological Analysis, 159.

Hamzeh, H., Madi, M., Alghwiri, A. A., & Hawamdeh, Z. (2020). The long-term effect of neurodynamics vs exercise therapy on pain and function in people with carpal tunnel syndrome: A randomized parallel-group clinical trial. Journal of Hand Therapy.

Ibrahim, I., Khan, W. S., Goddard, N., & Smitham, P. (2012). Carpal tunnel syndrome: a review of the recent literature. The open orthopaedics journal, 6, 69–76. Https://doi.org/10.2174/1874325001206010069

Mantzari, E., Galloway, C., Wijndaele, K., Brage, S., Griffin, S. J., Marteau, T. M., Chambers, A. J., Robertson, M. M., Baker, N. A., & The State of Queensland. (2019). Ergonomic guide to computer based workstations Table of contents. Applied Ergonomics, 78(June 2018), 37–53. https://doi.org/10.1016/j.apergo.2019.01.015%0Ahttps://doi.org/10.1016/j.pmedr.2018.11.012

Marryam, M., Yasmeen, R., Malik, T. M., Malik, A. N., & Amjad, I. (2018). A comparision of the effectiveness of neurodynamics versus nerve and tendon gliding exercises alone for carpal tunnel syndrome. Pakistan Armed Forces Medical Journal, 68(4), 924-29.

Nambiema, A., Bertrais, S., Bodin, J., Fouquet, N., Aublet-Cuvelier, A., Evanoff, B., & Roquelaure, Y. (2020). Proportion of upper extremity musculoskeletal disorders attributable to personal and occupational factors: results from the French Pays de la Loire study. BMC public health, 20, 1-13.

Ono, S., Clapham, P. J., & Chung, K. C. (2011). Optimal management of carpal tunnel syndrome. American Journal of Clinical Hypnosis, 53(4), 255–261. https://doi.org/10.2147/IJGM.S7682

Padua, L., Coraci, D., Erra, C., Pazzaglia, C., Paolasso, I., Loreti, C., Caliandro, P., & Hobson-Webb, L. D. (2016). Carpal tunnel syndrome: clinical features, diagnosis, and management. The Lancet Neurology, 15(12), 1273–1284. https://doi.org/10.1016/S1474-4422(16)30231-9

Pereira, M., Sebastian, A., Ashalatha, S., & Latha, T. (2013). Body Mechanics and Perceived Physical Health Problems among Computer Users. International Journal of Health Sciences and Research, 3(11), 73–79.

Pourmemari, M. H., & Shiri, R. (2016). Diabetes as a risk factor for carpal tunnel syndrome: a systematic

review and meta-analysis. Diabetic Medicine, 33(1), 10-16.

Rafn, B. , Hung, S., Hoens, A.., mcneely, M. , Singh, C. , Kwan, W., ... & Campbell, K. (2018). Prospective surveillance and targeted physiotherapy for arm morbidity after breast cancer surgery: a pilot randomized controlled trial. Clinical rehabilitation, 32(6), 811-826.

Raja k kutty, vijay mundhe. (2018). Burden of Dengue Related Neurosurgical Emergency. Asian Journal of Neurosurgery, 13(2), 29682044. https://doi.org/10.4103/ajns.AJNS

Roll, S. ., & Hardison, M. . (2017). Effectiveness of occupational therapy interventions for adults with musculoskeletal conditions of the forearm, wrist, and hand: a systematic review. American Journal of Occupational Therapy, 71(1), 7101180010p1-7101180010p12.

Roquelaure, Y., Nicolas, G., Pélier-Cady,. C., Mariot, C., Descatha, A., Leclerc, A., Raimbeau, G., Goldberg, M., & Imbernon, E. (2008). Attributable risk of carpal tunnel syndrome according to industry and occupation in a general population. Arthritis and rheumatism, 59(9), 1341–1348. https://doi.org/10.1002/art.24002

Salehi, S., Hesami, O., Poursaeed Esfehani, M., Khosravi, S., Rashed, A., Haghighatzadeh, M., ... & Abedi Yekta, A.. (2019). The Effectiveness of Exercise Therapy and Dry Needling on Wrist Range of Motion, Pinch and Grip Force in Carpal Tunnel Syndrome: A Randomized Clinical Trial. Asian Journal of Sports Medicine, 10(4).

Salehi, S., Hesami, O., Rashed, A., Hassabi, M., & Poursaeidesfahani, M. (2019). The Assessment of Acupuncture and Exercise Therapy in Patients with Carpal Tunnel Syndrome: Randomized Clinical Trial. Novelty in Biomedicine, 7(4), 201–209. https://doi.org/10.22037/nbm.v7i3.25274

Sharief, F., Kanmani, J., & Kumar, S. (2018). Risk factors, symptom severity and functional status among patients with carpel tunnel syndrome. Neurology India, 66(3), 743–746. https://doi.org/10.4103/0028-3886.232351

Shin E. K. (2019). Endoscopic Versus Open Carpal Tunnel Release. Current reviews in musculoskeletal medicine, 12(4), 509–514. Https://doi.org/10.1007/s12178-019-09584-0

Soc, J. J., & Hand, S. (2012). DASH score. Institute for Work & Health, 178–183. http://www.dash.iwh.on.ca/about-dash

Swords, M. (2018). Symposium - Hindfoot and Ankle Trauma. Indian, 52(may), 161–169. https://doi.org/10.4103/ortho.IJOrtho

Tanriverdi, M., Hosbay, Z., & Algun, Z. C. (2019). The relationship of pain on the upper extremity functions and quality of life in patients with carpal tunnel syndrome. Journal of Back and Musculoskeletal Rehabilitation, 32(1), 71–76. https://doi.org/10.3233/BMR-171097

Tiric-Campara, M., Krupic, F., Biscevic, M., Spahic, E., Maglajlija, K., Masic, Z., Zunic, L., & Masic, I. (2014). Occupational overuse syndrome (technological diseases): Carpal tunnel syndrome, a mouse shoulder, cervical pain syndrome. Acta Informatica Medica, 22(5), 333–340. https://doi.org/10.5455/aim.2014.22.333-340

Turner, Alexandra; Kimble, Frank; Gulyas Karoly& Ball, Jennifer. **(2010)** Can the outcome of open carpal tunnel release be predicted?: a review of the literature. ANZ J Surg. 8050- 54. 2.

Uchiyama S, Itsubo T, Nakamura K, Kat H, Yasutomi T& Momose T. 2010;Current concepts of carpal tunnel syndrome pathophysiology treatment, and evaluation. J Orthop Sci. **15**:1–13.

Unver, S., & Akyolcu, N. (2018). The effect of hand exercise on reducing the symptoms in hemodialysis patients with carpal tunnel syndrome. Asian journal of neurosurgery, 13(1), 31.

Yoo, W.. (2015). Effect of the release exercise and exercise position in a patient with carpal tunnel syndrome. Journal of physical therapy science, 27(10), 3345-3346.

White, H., & Sabarwal, S. (2014). Quasi-experimental design and methods. Methodological briefs: impact evaluation, 8, 1-16.

Zidkova, V., Nakladalova, M., & stepanek, L. (2019). Effects of Exercise and Enzyme Therapy in Early Occupational Carpal Tunnel Syndrome: A Preliminary Study. Biomed research international, 2019.

Zwolińska, J., & Kwolek, A. (2019). Factors determining the effectiveness of conservative treatment in patients with carpal tunnel syndrome. International journal of occupational medicine and environmental health, 32(2), 197-215