

**EFFECTIVENESS OF HAND THERAPY INTERVENTION FOR  
CARPAL TUNNEL SYNDROME PATIENTS AT CRP**



By

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## **Statement of Authorship**

Except where is made in the text of the thesis, this thesis contains no materials published elsewhere or extracted in whole or in part form a thesis presented by me for any other degree or diploma or seminar.

No others person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the alert of any other degree or diploma in any other tertiary institution.

The ethical issues of the study has been strictly considered and protected. In case of dissemination the finding of this project for future publication, research supervisor will highly concern and it will be duly acknowledged as undergraduate thesis.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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## Abstract

**Background:** Carpal tunnel syndrome can often be effectively treated in a primary care environment. In Carpal tunnel syndrome daily activities and occupation are hampered because of severe pain when moving the wrist. It is not a cause of disability, pain may limit productivity.

**Objectives of the study:** The objectives were to find out the effectiveness of treatment protocol for carpal tunnel syndrome.

**Methodology:** It was a quasi- experimental, pretest-posttest design of quantitative research. In this research, total 9 participants were selected and data was collected by using convenience sampling method. Patients were allocated for 4 weeks: treatment sessions were applied for the group, the assessment was done again on a post- test on the same group by the same scales and changes between pre and post-test of the same groups were compared. Pain was measured by VAS scale; Hand function was measured by Royal Air Force scale; Hand Strength was measured by Jamar Dynamo meter; Pinch Strength was measured by Pinch Gauge; and Range of Motion was measured by Goniometre.

**Result and Discussion:** In this study, the result shows positive changes in all the parametric outcome measure of the outcome area. At the end of the treatment sessions each of the participants had improvements to varying degree. However, OT treatment was more effective, especially for the outcomes of lessening symptom severity, pain reduction and patient satisfaction.

**Conclusion:** Therefore, hypothesis can be proved that 4 weeks Occupational Therapy treatment was effective in treating CTS patients resulted in better outcomes. For long term effectiveness, the treatment program should be started as early as possible as part of the best practice for carpal tunnel syndrome patients.

**Key words:** *Carpal Tunnel Syndrome (CTS); Effectiveness; Outcomes;*

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## **List of Abbreviations**

**ADL:** Activities of Daily Living

**OT:** Occupational Therapy

**CRP:** Centre for the Rehabilitation of the Paralysed

**CTS:** Carpal tunnel syndrome

**BHPI:** Bangladesh Health Professions Institute

**SPSS:** Statistical Package for social science

**VAS:** Visual Analogue Scale



# CHAPTER 1 INTRODUCTION

## 1.1. Introduction

The hand is a vital element of the human and it plays an important role in activities of daily living. From birth, human beings learn from touch which enhances them to contribute by using the hand. Hands have lots of receptor on the skin that introduces humans to different stimulus in the environment. It has a complex anatomical structure that helps the hand to modulate the different activities. Due to unavailable circumstances, hand injury are often cause to the disruption of the structure. Hand therapy services always assist the individual to promote hand function and approve active participations in activities of daily living. Hands allow us to act on our world through contact with our own and other bodies and through contact with objects. Hands are the tools which are most frequently used to accomplish work, to play and to perform self-maintain tasks. Due to any disturbances or disability, people can affect to show his or her hand skills, less opportunity to take sensory information from the environment. The involvement of the patient's in hand therapy program to regain ability and effective use of the hands to engage in daily occupational activities that it depends on a complex's interaction of hand skills (Agnihotri *et al.* 2006).

In 2011, American Society for Surgery of Hand expressed that Hand therapy is a developed rehabilitation intervention which is performed by experienced and qualified occupational therapist for patients with CTS. After injury, patients are losing their role and their quality of life decreases (American Society for Surgery of Hand, 2011).

Hand Therapy is the art and science of rehabilitation of the upper limb - shoulder to hand. It involves evaluation and testing to assess the injured limb from which a specific treatment program can be designed. A variety of specialized treatment techniques are used to achieve these goals (Australian Hand Therapy Association, 2014).The quality of hand therapy service can be enriching if ensure appropriate treatment protocol on the basis of individual need. In the country perspective, CTS is the more common so there is a need to have adequate care, along with their identifying risk factor and functional limitation for CTS. The quality of hand therapy service can be inspiring if ensure appropriate treatment protocol on the basis of individuals need. In the country

perspective, CTS is increasing day by day due to their repetitive movements. So expectation is the most important part of the service management. All of patients expect their outcome about their hand depend upon the quality of effectiveness of service and try to find out the effectiveness of treatment protocol for carpal tunnel syndrome patients of hand therapy services.

## **1.2. Background of this study**

Most of the people of Bangladesh engage in cultivation and manual work. In the work place and home people do repetitive work because modern techniques are not available, housewives have to perform lots of repetitive activities e.g. clothes wringing, lifting any objects. Men who engage in factory work doing forceful activities of wrist motion are at a risk of developing CTS. In CTS the person suffers from pain and they are able to use their affected hand. When they hold any objects, they feel pain and they are not able to maintain their work. If a person has the limitation of activity then it will influence his or her productive life.

Most of the CTS patients may have sensory impairments such as tingling, decreased sensation, decreased grip/pinch strength, and muscle wasting (Robert *et al.* 2009). It may impact on activities of daily living. Due to prolonged grasping of the wrist or untreated carpal tunnel syndrome, patients may experience loss of hand function. In severe and chronic cases, most of the time muscle damage or atrophy may occur. Sometimes, complete sensory loss in the hand has also been reported (Syedmozafor *et al.* 2007). For this reason, it decreases the person's ability to grasp and they cannot perform object manipulation, for this that can impact of resulting in impaired motor performance. In clients with CTS, interventions are needed to change these clients' factors. Practitioners have many potential treatment options for conservative management of carpal tunnel syndrome.

CTS is a common upper extremity entrapment neuropathy and intervention strategies presently include attempts at prevention of the disorder, conservative nonsurgical interventions, and surgical options .The prevalence of "clinically certain" CTS is 3.8% (Ibrahim *et al.* 2012). CTS caused the most time missed from work "among major

disabling workplace injuries and illnesses” at 27 days on average .In the United States, carpal tunnel release is one of the most common hand and wrist surgeries performed, with approximately 400,000 conducted per year. In the workplace, CTS results in lost days of productivity and wages, high health care costs, and workers’ compensation claims (Dale *et al.* 2013).

Incidence of carpal tunnel syndrome in the community has been shown to be surprisingly high. De Krom *et al* sought histories compatible with carpal tunnel syndrome in 1000 adults in a community and authenticated the diagnosis in those with the appropriate history by nerve conduction studies. They found that 3.4% of adult females were known to have carpal tunnel syndrome with an additional 5.8% of females in whom the condition had not previously been detected. The prevalence can only be a minimal estimate (some patients with an appropriate history refused nerve conduction studies and were classified as not suffering from carpal tunnel syndrome, despite the appropriate history). Ferry *et al* performed a similar study in the United Kingdom with a prevalence estimate of between 7% and 16%, concluding that the condition was common in the general population ( Burke *et al.* 2003).

Based on both clinical symptoms and nerve conduction tests, overall prevalence's of 3.0–5.8% among women and 0.6–2.1% among men have been found in general population samples. (Thomsen *et al.*2008). Kouyoumdjian *et al* found that Prospective population-based studies have shown that the prevalence of electro physiologically confirmed CTS in the Netherlands in 1985 was 5.8% in women and 0.6% in men; in another survey performed in southern Sweden in 1999, the authors found a 2.7% prevalence of symptomatic subjects with clinically and electro physiologically confirmed CTS.

Beyond cost-effectiveness, there are some reasons for choosing conservative interventions over surgical treatment. First, in some localities, there may be a long wait for surgical intervention by transverse carpal ligament release. Second, there are risks of preoperative injuries and postoperative complications such as nerve injury, infection, and tendon injury. Third, conservative treatment may be effective in managing symptoms, and the scientific literature provides evidence in support of some conservative therapies. Hand therapists may use a variety of conservative interventions in their management of persons with CTS.

### **1.3. Significance of the study**

An Occupational Therapist can improve the daily performance and quality of life of a patient with carpal tunnel syndrome by combination of education, setting feasible goals, using adaptations in physical environment, training compensator skills, on patient behavior seemed to be successful. This study can be helpful for Occupational Therapy Professionals because it will provide an evidence of practice through working with CTS. As a result it will help to increase confidence level of OTs. It could be a good resource for OT department. It will help to increase referral system to OT department. It will be helpful to develop a comprehensive treatment protocol for patients with CTS. It is the first study of Occupational Therapy profession in Bangladesh. With this study we can get idea about need of awareness-raising for CTS. So in this situation, this study might helpful for CRP as well as Bangladesh. The study findings can be helpful for upgrading Occupational Therapy services in Bangladesh and contributing to professional development. As a result, it is essential to find out the effectiveness of hand therapy intervention after receiving OT service.

### **1.4. Aim and Objectives of the study**

#### **Aim of the study**

The purpose of this study the effectiveness of treatment protocol for carpal tunnel syndrome

#### **Objectives of the study**

- To find out the effectiveness of treatment protocol for carpal tunnel syndrome.

### **1.5. Null Hypothesis**

Occupational Therapy Treatment Program cannot change the outcome of post-test in the management of carpal tunnel syndrome.

### **1.6. Hypothesis**

Occupational Therapy Treatment Program there is change the outcome of post-test in the management of carpal tunnel syndrome.

## CHAPTER 2 LITERATURE REVIEW

### 2.1. Carpal tunnel syndrome (CTS)

Carpal tunnel syndrome (CTS) is a painful progressive condition that may cause weakness of the hand, wrist and fingers which may be occurred by compression on the carpal bones where a major nerve that passes at the front of the wrist and may become compressed on the nerve if the tissues inside the tunnel for this it has swollen, the tendons are inflamed. When there is pressure on the median nerve, then the nerve can interpret the affected sense of touch and hand movements it may be also caused by everyday repetitive movements or by fluid preservation (Muller *et al.* 2004). to know how to CTS arise and it is most necessary that the carpal tunnel ,The Median Nerve and Flexor Tendons can involve in the parts of the hands and wrist.

Researchers have identified a variety of factors that may cause or contribute to the development of carpal tunnel syndrome. Synovial fibrosis, metabolic syndrome, diabetes, thyroid disorders, rheumatoid arthritis, pregnancy, and menopause. And engagement in an occupation or activity these factors include the presence of commonly noted co-occurring health conditions are non-inflammatory that involves repetitive use of the hand, and the presence of a range of personal or physical factors that may indicate a predisposition to carpal tunnel syndrome.

The carpal tunnel is a narrow passage way on the palm side of the wrist. Surrounded by bones and ligaments, the carpal tunnel houses and protects the tendons of the hand and the median nerve, which controls sensations to the thumb and fingers. When the median nerve becomes pinched or compressed due to swelling or irritation in adjacent tissues or tendons, the result can be pain, numbness, hand weakness, and in extreme cases, loss of hand function. Cases of bilateral carpal tunnel syndrome have been reported, but typically only one hand is affected .Carpal tunnel syndrome is rare in children, it usually occurs only in adults. The symptoms are numbness, burning, or tingling in the fingers and palm of the hand Pain in the wrist, palm, or forearm, decreased grip strength, weakness in the thumb, difficulty in personal between hot and cold. Symptoms may cause waking during the night with the urge to “shake out” the hand or wrist and Symptoms may occur with

activities that require prolonged grasping or flexing of the wrist, whole carpal tunnel syndrome can progress to determine numbness and permanent loss of hand function and muscle damage or atrophy may occur. In severe and chronic cases of this, there may be loss in the hand sensation that has also been reported.

## **2.2 Prevalence**

CTS is a common health problem in Bangladesh especially most of the women are affect, that can affect the nerves of the hand which are very common in women than men. It can estimate that have more or less 5% of women and 3% of men are CTS. In one study suggested that it can occur in the general population of 1% to 3% (Ferry *et al.* 1998). It is one of the fastest-growing occupational illnesses in the United States and people who work in the meat packaging, newspaper, poultry, textile, and electronics industries. American Family Physician estimates that from 3% to 6% of adults in the general population suffer from carpal tunnel syndrome. A recent study shows that CTS occurs at a rate of 3.46 cases per thousand persons. Most cases of CTS can develop in people who are between 45-64 years of age (Anthony, 2003). High prevalence rates have been reported in people who perform certain repetitive wrist movement.

## **2.3 Diagnosis criteria**

Possible complications of CTS that may cause include pain during gripping or functional activities. Sometimes patients avoid doing activities due to chronic pain in wrist. (Hand & Wrist Trearments, 2009). For the carpal tunnel syndrome, diagnosis is made by the history, clinical signs, with a physical exam of the hands, wrists and arms. Any swelling or mark of the skin and the muscles of the hand will be tested for strength that will note by the physician and occupational Therapist. Sometimes the investigator asks the Patients to indicate where their symptoms are, including pain, numbness and tingling, by locating the affected on the areas .They may also be asked to rate of severity of their symptoms and diagnosis is likely if at least two of fingers 1, 2, or 3 have these symptoms, and if pain is present in near the wrist. The doctor or therapists may take an x-ray to diagnosis the CTS.

Occupational therapist use test to reproduce symptoms of CTS that are Phalen's test (wrist-flexion), Tinel's test (Tinel's sign), Median Nerve gliding places. Phalen's test can be used and the patient is asked to press the backs of the hands so that the wrist is bent against each other. Phalen's plan is positive when the wrist flexion for one minute and the elicit symptoms can be arise in the median nerve for the symptoms are distributed. Tinel's test (Tinel's sign) - the doctor and Therapist taps the median nerve at the wrist lightly to see whether the patient feels numbness or tingling in one or more of the fingers. The UK National Health Service says that this test may be helpful, but is not reliable. Median Nerve gliding places-Median Nerve gliding places tension on median nerve at the wrist by extending the wrist should be compared to uninvolved side if possible. Sometimes X rays can be used to notice fractures in the wrist that can be the cause of carpal tunnel syndrome. Magnetic resonance imaging is also a useful tool for visualizing injury to the median nerve (Milton .S. Hershey Medical Center, 2013).

## **2.4 Effectiveness**

The need of the study is to investigate the effectiveness of conservative management of carpal tunnel syndrome. Effectiveness is most important, and the researcher used find out the effectiveness of treatment protocol for carpal tunnel syndrome patient. So Effectiveness is used to find out the result which is the capability of producing a desired result. When something is used which is very important to the condition of the patient that can be deem effective, it means it has an intended or expected outcome that may be great idea.

The study is titled 'Evaluation of the clinical efficacy of the conservative treatment in the management as a review of carpel tunnel syndrome'. This study mentioned the etiology of carpal tunnel syndrome and diagnosing methods and they also revealed that Conservative managements like ultrasound therapy, therapeutic splinting, and exercise and job modifications are effective in the management of carpal tunnel syndrome (Ahamed *et al.* 2007).

The study titled 'comparison of three conservative treatment protocols in carpal tunnel syndrome'. In this study they took 28 female patients and investigate and compare the effectiveness of 3 different combinations in conservative management of CTS, the combinations include tendon and nerve gliding exercise with splinting, ultrasound combination with splinting, ultrasound and splinting with tendon and nerve gliding exercise. The result of the long term satisfaction questionnaire, grip power measurement reveals that symptomatic improvement in the group treated with ultrasound therapy and splinting along with tendon and nerve gliding exercise is effective immediately and 8 weeks after the treatment (Baysal *et al.* 2006).

## **2.5 Outcome**

The researcher finds out the outcome of carpal tunnel syndrome patient to use the conservative treatment protocol. An outcome is a change that is likely to take place as a result of the target population's who participation in the program.

Finch *E. et al* (2008) in their book Physical rehabilitation outcome measures commented that Visual Analogue Scale (VAS) directly measures the intensity of pain and therefore has high content validity and has high test-retest reliability.

In that study had titled as vital analysis of outcome measures used in the assessment of carpal tunnel syndrome. In this study, they critically analyzed the theoretical framework, validity, reliability, responsiveness and appropriateness of some of the commonly used 6 CTS outcome measures. It reveals that Boston Carpal Tunnel Syndrome Questionnaire, Michigan Hand Outcome Questionnaire and Patient Evaluation Measure have comprehensive frame works, good validity, reliability and responsiveness both in the hands of the developers, as well as independent researchers. It clearly shows Boston Carpal Tunnel Syndrome Questionnaire have good validity, and reliability (Senthil *et al.* 2008).

## **2.6 Functional problem**

In our hands, the acting muscles are subdivided into two groups: the extrinsic muscle and intrinsic muscle groups. Primarily extrinsic muscle coordinates the powerful gripping and



gross action (e.g.: lifting) of the hand and the intrinsic muscle are primarily responsible for intricate finger movements and fine motor control (e.g. eating, writing etc).

Carpal tunnel syndrome can minimize hand function. After CTS the patient feels difficulties to accomplish their daily living activities due to impairment of the extrinsic muscle and intrinsic muscle groups. These muscles are connected to the finger bones by tendons. Contraction of the muscle pulls on the tendon to move the finger. In our hand if there is CTS the persons are faced in fine and gross motor movements. Although the persons have difficulty in CTS, they cannot perform their functional activities such as self-care, productivity and leisure).

## **2.7 Importance of occupational therapy intervention for CTS**

Occupational therapy is very important to the patient when they have any injury in the hand .Because they have lost their life role and their quality of life for the CTS. Through occupational therapy, functional activities can be restored through specialized skills in treatment (American Society of Hand Therapist, 2008).

The occupational therapist provides various exercise and treatments because of our specialized training and expertise. This advanced knowledge and training enables us to treat individual who sustain hand or upper extremity injuries with the most up to date information, techniques and protocol in order for them to return more quickly to a functional lifestyle (Hand & Upper Extremity Rehabilitation, 2010).

## **2.8 Occupational Therapy Intervention for CTS**

### **Wrist splint**

Wrist splints can keep the wrist from falsification. The pressure in the carpal tunnel is lowest and maintain in neutral wrist flexion and extension range, with the pressure raising much as the wrist is moved into flexion or extension. Splints may grasp the wrist in neutral are often helpful in controlling symptoms of mild to moderate severity. It is very helpful to provide the most appropriate in CTS patients. There is a resistance to advise continuous splint use and most hand therapists choose the use of splints at night and only

occasionally during the day, if there are particular activities likely to worsen symptoms. Wrist posture must be adjusted with palm and finger (Burke, *et al.*2003)

### **Nerve and tendon gliding exercises**

Tendon and nerve gliding exercise are particularly valuable in the management of postoperative carpal tunnel patients. However, the technique has also been shown to be of benefit in patients being measured for surgery. Rozmaryn *et al* reviewed more than 200 hands under alarm for carpal tunnel syndrome patients. Altogether 71% of the patients who were not offered gliding exercises went ahead to surgery; only 43% of the gliding exercise group was felt to require surgery. Care should be taken that the frequency and force of the exercises is not so great that exacerbation of symptoms is forced. The beneficial effect of gliding exercises may be the mobilization of the nerve directly or facilitation of venous return or edema dispersal. Early cases of carpal tunnel syndrome may benefit from the use of this treatment option (Burke *et al.*2003)

### **Manual Therapy**

Manual Therapy treatment effectiveness could be related to specific manual therapy techniques. Carpal bone mobilization mutual with flexor retinaculum extend effectively relieved pain, but carpal tunnel relief trick with stretches of digits three and four did not significantly change nerve (Muller *et al.* 2004).

### **Workplace task modification**

Task modification that reduces metacarpophalangeal joint flexion range will reduce lumbrical incursion and can control symptoms. Heavy manual workers with large lumbricals may be at increased risk of carpal tunnel syndrome if grateful to grip firmly for prolonged periods of time. However, Kerr *et al* biopsied the synovial in over 600 cases at carpal tunnel decompression and found acute or chronic synovitis in only 4% of cases. Occupational therapists can offer workers and their employers advice on task modification, which will frequently control mild or moderate symptoms of carpal tunnel syndrome (Burke *et al.*2003).

## **CHAPTER 3 METHODOLOGY**

### **3.1 Study design**

It was a quasi- experimental design of quantitative research. This study was a single group and provides an intervention during the experiment. This design did not have a control group to compare with the experimental group.

Quasi experimental design differs from a true experimental design in that, although it contains an independent variable that is manipulated in order to look for an effect on a dependent variable, either control group or randomization is lacking. These designs are useful to researcher looking for validation of treatment method and techniques, (Bailey, 1997, p.47). In experimental design, all three of the components- manipulation, control and randomization-are required.’’, (Bailey 1997, p.46-47). But in this study all the three components were not present.

Therefore, this study was a quasi experimental research design. Here, standard occupational therapy treatment was applied to the patients who were suffering at carpal tunnel syndrome.

#### **Pretest-Posttest design:**

The Pretest-Posttest design is valuable in describing what occurs after the introduction of the independent variable.

0 X 0

This design can answer questions about change over time in that the pre test is given before the introduction of the independent variable. If the subjects are tested before the intervention, a change in scores on the dependent variable can be reported but cannot be attributed to the influence of the independent variable (Depoy & Gitlin, 1998).

### **3.2 Study area**

The Researcher was conducted the patient with CTS at Hand Therapy Unit of Centre for the Rehabilitation of the Paralysed (CRP) - Savar and Dhaka-Mirpur.

### **3.3 Sampling**

Nine participants with CTS were collected by using convenience sampling from the Hand Therapy department of CRP (Savar & mirpur). CTS is a rare case in Bangladesh. Baily (1997) stated that ‘in convenient sampling participant are choose which can be studied most easily, cheaply or quickly.

After the initial assessment in the department, the patient who had matched the criteria was collected as sample. Then, the entire sample was given a numerical number such as 1, 2, 3, etc.

The researcher established inclusion and exclusion criteria and selected those individuals who fit these factors and volunteer in the study (Depoy & Gitlin, 1998).

The convenience sampling method is based on the judgments of the researcher, In that a sample is made of elements that embrace the most characteristics of the population to the study and after proper diagnosis by doctor and Occupational therapists then the samples were taken for this study (Hicks, 1999).

### **3.4 Participants**

Researcher took nine participants from Centre for the Rehabilitation of the Paralysed (CRP), Savar, and Mirpur.

### **3.5 Data collection procedure**

- Observation
- Interview
- Engage functional tasks such as power grip, button etc
- Test and measures

### **3.6 Method of data Collection**

#### **Data collection Tools:**

This research was quantitative exploration of the effectiveness of Occupational Therapy Treatment Program for carpal tunnel syndrome patients. To understand the effectiveness Occupational Therapy Treatment Program for carpal tunnel syndrome several

measurement tools were used, such as; Visual Analogue Scale (VAS), Jamar Dynamometer and pinch gause, Goniometer, Royal air force scale.

### **Visual Analogue Scale (VAS)**

The VAS is a popular means of measuring pain in a variety of clinical contexts. It is most commonly used to measured pain intensity, but it can be used for other dimensions of pain like pain relief and pain affect. It is a line of define length (10cm) usually horizontal, anchored at each end by a descriptive word phrase representing the extremes. The respondent places a mark on a line to indicate the point at which his or her response best answers the questions ask. A number of items, which aims to assess pain, symptoms and quality of life, utilize the VAS; where by respondent makes a judgment of how much of the scale is equivalent to the intensity of the domain. The has numerical values display at regular intervals along the line in order to help respondents to intuitively understand of the scale(this is known as a numerical scale of Likert scale of VAS).The pain is subjective but the measurement is in centemeters/millimeters.The result of VAS can therefore treated as interval or ratio data (Hick,1999).

For this study in the questionnaire in the VAS “0” representing no pain and “10” representing the highest pain. The pain marked by the participants about his pain score and counts the scores from the left to tight centre meters. It is claime to have a high degree of reliability, especially when used serially on a giving client (Waterfield& Sim 1996). A VAS which is commonly interprete as valid report of subjective pain used to record degree of pain (Richard,et al.1996). The disadvantage is that it cannot be use to compare one patient with another.

### **Jamar Dynamometer and Pinch Gause**

Jamar Hand Dynamometer is ideal for routine screening of grip strength and initial and ongoing evaluation of clients with hand trauma and dysfunction. Jamar Hand Dynamometer is virtually leak-proof hydraulics and isometric design ensures accurate, reproducible results and years of reliable service. Jamar Hand Dynamometer is built to last, a shock-resistant rubber cap protects the stainless-steel gauge and a wrist strap prevents accidental damage if dropped. Jamar Hand Dynamometer has dual-scale readout

displays isometric grip force from 0 - 200 lbs. Peak-hold needle automatically retains the highest reading until reset. Rotate the peak-hold needle counter-clockwise until it reaches zero. After the patient has used the North Coast Hydraulic Hand Dynamometer, record the reading. Reset the peak-hold needle to zero before recording new reading

### **Goniometre**

A goniometre is a device used in physical therapy to measure the range of motion around a joint in the body. Measuring joint range of movement used in various ways dependently on the joints that is measure. There are two "arms" of the goniometre: the stationary arm and the moveable arm. Each arm is positioned at specific points on the body and the center of the goniometre is aligned at the joint to be measured. There are hash marks on the center of the goniometre that your physical therapist uses to precisely measure joint range of motion (Hamilton, 1997)

### **Royal air force scale**

Hand function Activities measured by Royal air force scale. The Royal air force is a generic calculation of disability applicable to many different patient populations and is the most widely adoptee functional status measure. The Royal air force scale used to trace such changes and analyses the outcomes. It is most useful in rehabilitation, but it was also use in acute care.

The Royal air force scale is exceptionally well validating in international trails. It is reliable, valid and responsively in all these settings. Significant trading and certification are requiring standardizing assessment. The Royal air force scale can be use in isolation, but as an indicator of activity limitations Each item scored on a 5-point Likert scale indicative of the amount of assistance required to perform each item (0=impossible, 4=normal).

In this study, Royal air force Scale used to measure the overall hand function and ADL before the Pre-test and the post-test.

Royal air force Score - Ability to perform tasks.

- 0- Impossible
- 1- With much assistance
- 2- With little assistance
- 3- Manage with min difficulty
- 4- normal

### **3.7 Data Collection process**

The data collector fixed a date and time with the participant to his available time. At first the data collector informed the participant about the contents of the consent form. All participant names coded to maintain confidentiality, diagnosed and referred by qualified occupational Therapist, physiotherapist and doctor. Each participant received hand therapy intervention for CTS.

Participant evaluated by Visual Analogue Scale (VAS), Goniometre, Jamar Dynamometer, Royal air force scale. The participants of the research chosen purposively for the experiment. Then the data collector measured pain, joint range of motion, overall hand function, and muscle strength of patient with CTS.

The participant received treatment as regular patients in the Occupational Therapy department of CRP; they continue their treatment as per their schedule. Each participant received 4 weeks of a treatment program arrange by the researcher with the permeation from the Occupational Therapy department.

Before started the treatment there did the initial assessment where the researcher assessed pain, joint range of motion, overall hand function, and muscle strength of the muscle of patient with CTS that carried out in each area that provides the pretest score.

After receiving 4 weeks intervention program, then the data collector was collect subjective and objective information including the pain in VAS, joint range of motion, hand function, and muscle strength of each participant, but the treatment applied by qualifies Occupational Therapist. And the data collector instructed the appointee about

the treatment protocol. During this time, the participants were continued their treatment as per their schedule. Each participant received 4 weeks of a treatment program arranged by the researcher with the permission from the Occupational Therapy department, that was carries posttest score.

### **3.8 Inclusion criteria**

- Patient who has diagnosed and referred by occupational Therapist, physiotherapist and doctor
- The study evaluated one or more Occupational therapeutic interventions that could be used by occupational therapists according to their scope of practice.
- Both male and female patients

### **3.9 Exclusion criteria**

- Patient who has had surgery in his or her hands for removing CTS.
- Patient who has wrist fracture.

### **3.10 Ethical consideration**

- Researcher took permission from the authority of CRP.
- Researcher maintained confidentiality about service information of the institutes.
- Informed consent collected from the participants.
- Researcher ensured that the confidentiality is maintained about the participants.
- All participants were informed about the aim of the study.
- The researcher was available to answer any study related questions or inquiries from the participants.



## CHAPTER 4 DATA ANALYSIS AND RESULTS

### 4.1 Data Analysis

Data analysis was done with statistical calculation using inferential statistical parametric paired 't' test which is performed during numerical data system as conveniently selected of the subjects for the participants. A quantitative research data analysis occurs at the conclusion of data collection (Bailey, 1997).

In this study, during the data analysis these sequence data was converted into numerical data by giving a specific value for specific sequence data. In this study there were eight variables. The every variables may come different score in this research. The researcher took the average of those sub division and makes them into one variable. In this study there were 8 variables that were categories and they are hand function, hand strength, pinch strength, wrist flexion, extension, Radial deviation and ulnar deviation, pain interfering daily activities.

All the participants told about different variables before starting treatment and after completing the 4 weeks treatment sessions and were scored by the data collector.

In this study, using a same- subject groups were conveniently allocated to the treatment program group. The same – subjects were used for each level of the independent variable (Thomas *et al*, 1979). Outcomes were measured by collecting the scores of different variables and the scores of the interval data were considered. The pretest and post-test comparison group design is one of the most extensively used methods to evaluate clinical research (Harmon, 2003). The common methods of analyzing data form a pretest and post-test research design that are related 't' test on the different score between pre test and post test. So, for this study were used paired samples 't' test to calculate the significance level of the study. The 't' test was used to find out whether the 't' values were represented differences between the results from before received treatment and after received treatment of the same group of the participants.

**The 't' formula:**

Formula of related 't' test: 
$$t = \frac{\sum d}{\sqrt{\frac{N \sum d^2 - (\sum d)^2}{N-1}}}$$

Where,

$\sum d$  = the total of the differences

$(\sum d)^2$  = the total of the differences squared

$\sum d^2$  = the total of the squared differences

N = Number of participants.

N-1 = degree of freedom. The sign is df. A complex concepts involved in some statistical tests

Which refers to the extent to which data have the capacity to vary one certain limit has been Imposed (Hicks, 1999).

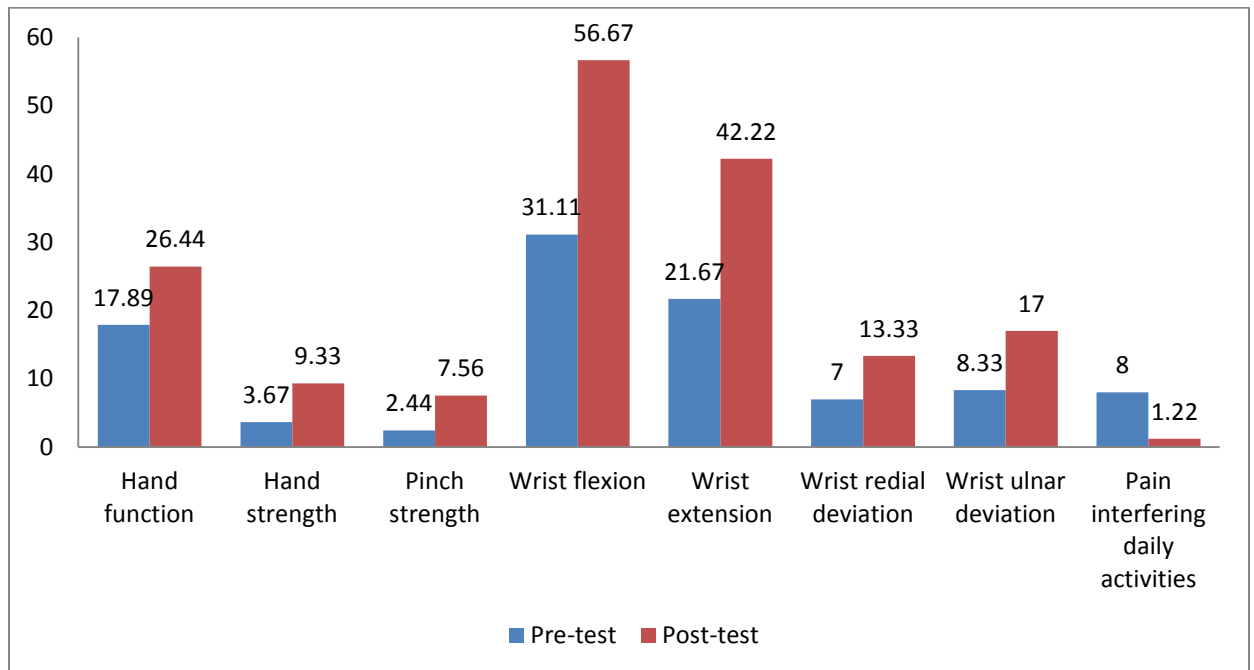
$\sqrt{=}$  The square root of the final calculation of everything under the square root sign. In this study, the hypothesis was one tailed as it was predicting a specific direction to the results (Hicks, 1999). To support the hypothesis and/or to reject the null hypothesis the researcher used related 't' test to find out the 'p' value so that the result can be significant.

## 4.2 Results

**Table 1:** shows variables in the study statistically significant at the following level of significance:

Variables	Mean pretest	Mean post-test	Mean difference	't' value	'p' value
Hand function(Royal air force scale)	17.89	26.44	8.55	8.315	.0005
Hand strength(kg)	3.89	9.33	5.44	6.314	.001
Pinch strength(kg)	2.44	7.56	5.12	8.693	.0005
Wrist flexion( in degree )	31.11	56.67	25.56	11.240	.0005
Wrist extension( in degree )	21.67	42.22	20.55	9.041	.0005
Wrist radial deviation( in degree )	7.00	13.33	6.33	10.539	.0005
Wrist ulnar deviation( in degree )	8.33	17.00	9.33	7.076	.0005
Pain interfering daily activities	8.00	1.22	6.78	12.387	.0005

From the above we can see the difference before and after receiving treatment.



**Figure 1:** show the mean improvement in different variables between pre test and post-test.

### **4.3 Interpreting the Result**

The total findings of the outcome measures represent that, the mean score of pre- test of participants that applying treatment protocol for CTS patients and after applying that protocol (data is presented in table 1). Therefore the mean score of participants of total findings improved after applying treatment protocol for CTS patients for this improved of hand function, hand strength and pinch strength. The study shows that the average score after receiving treatment is greater than before receiving treatment. Statistical analysis of the data represented that the probability of the random error and the usual cut-off point for claiming support for significant level of the experimental hypothesis is 5% (Hicks, 1999) therefore it can be said that the findings of the study is significant.

The overall findings in the area of wrist flexion, wrist extension, radial deviation and ulnar deviation represent that, the mean score of participants before applying treatment protocol for CTS patients and after applying treatment protocol for CTS patients. The overall finding is showing in table 1. Therefore the mean score of participants in the area of wrist flexion, wrist extension, radial deviation and ulnar deviation improved after applying treatment protocol. The study showed that the average/mean scores were better after receiving treatment protocol for CTS patients than before receiving treatment protocol for CTS patients' .Statistical analysis of the data represented in this area. This means that the probability of the random error is less than 1 people among 100 people. The usual cut-off point for claiming support for significant level of the experimental hypothesis is 5% (Hicks, 1999) therefore it can be said that the findings of the study is significant. The bar chart (figure 1) is representing the improvement rate of each of 9 participants before and after applying treatment protocol for carpal tunnel syndrome patients.

This study finds out that pain represent that, the mean score of participants before applying treatment protocol for carpal tunnel syndrome patients and after applying this protocol. The overall finding is showing in table 1. Therefore the mean score of participants in the area of pain reduction after applying treatment protocol for CTS .This result demonstrates that the average score after receiving treatment was greater than before receiving treatment.

## CHAPTER 5

### DISCUSSION

The purpose of the study was to find out the effectiveness of an occupational therapy treatment program for carpal tunnel syndrome of the hand and the objectives were to evaluate the occupational therapy treatment effectiveness in case of carpal tunnel syndrome of hand and to see the improvement rate of the participant and to make a specific treatment protocol for carpal tunnel syndrome of hand.

A study conducted by Chung *et al.* (1999) under a pilot non-randomised controlled trial design with 187 participants with CTS and found that splinting, nerve and tendon gliding exercise was very effective for hand function of patients with CTS. Hand function of all participants was measured by using the royal air force scale. Hand function measured before and after the six-week period of treatment. Another study conducted among 51 participants with CTS where hand function measured by Functional Status Scale and found a significant result (Brininger *et al.* 2007). In this study, researcher found that there is a highly significant improvement of hand function after receiving occupational therapy treatment program.

In Hong Kong a study conducted with 50 patients with CTS who were treated over 20 weeks where researchers found that OT treatment (splinting and contract bath) is effective (Li-Tsang *et al.* 2005). Moraska *et al.* 2008 conducted a study in the United States with 27 CTS participants and provided message therapy for 6 weeks and found that message therapy is effective for improving hand strength. In this study researcher also provided splinting, contract bath and message therapy and significant effectiveness of hand strength.

A randomized controlled trial design done by Robert *et al.* (2005) among 74 patients where 37 participants were under control group and another 37 participants were under treatment group. 37 participants who were under treatment group received ultrasound, laser therapy, splint and pumping exercise for 4 weeks. That study showed that pinch strength improved of patients with CTS who took treatment. On that study, it was also

confirmed that a significant improvement in overall hand function, activities of daily living, pain, and satisfaction with hand function. Researcher found almost similar result in terms of improving pinch strength after receiving OT treatment.

Measuring OT treatment among 44 CTS patients a study was conducted in Australia focusing on controlling pain, increasing flexibility of ROM (Katz et al. 2001). Participants took 6 weeks OT treatment and showed a significant improvement of wrist flexion after treatment. In this study researcher found that OT treatment for CTS was effective for reducing patient's pain and increasing range of motion.

A study was done by Sanford and Dana (2009) among 21 participants with CTS. They provided splinting to the CTS patients to increase mobility and decrease pain. In that study 21 participants took 6 weeks intervention. Effectiveness of the treatment was measured by goniometre and VAS. Before every treatment they measure mobility and pain to find out a base line score. They analyze the result through t-test comparing the score of before and after treatment. They got a significant result of OT treatment of CTS patients. In this study researcher found that OT treatment for CTS was effective for reducing patient's pain and increasing range of motion.

Carina et al. 2005 conducted a study to find out the effects of short- term, high intensity exercise program on self reported pain, function and quality of life among 61 participant with CTS. Participants were randomly assigned to intervention (n=30) or control group (n=31). Interventions were provided for 6 weeks. In the exercise group, an improvement was seen after 6 weeks and control group had no change. Researcher found similar result after conducting the study that radial deviation improved after 4 weeks treatment sessions.

According to Michael et al. (2004) an evaluation of a therapeutic exercise program was held to reduce pain and improve range of motion. In this study 67 participants were selected by randomized into a treatment intervention group (n=34) and a control group (n=33). Participants in the intervention group were instructed in 8 weeks. Result

suggested that wrist exercise can be effect in reducing pain and improve range of motion. They found that significant improvement of ROM in wrist. In this study, researcher found that there is a highly significant improvement of ulnar deviation after receiving occupational therapy treatment program.

A study was done by Baron et al (2002) in Sweden where 45 participants with CTS were randomly assigned to intervention (n=23) or control group (n=22). Intervention group took splinting, nerve and tendon gliding exercise, laser therapy and pumping exercise for 5 weeks. Before taking treatment, pain was measured by VAS scale to get baseline information. After 5 weeks post treatment, a significant change observed among the intervention group. Most of the participants under intervention group reported that their pain reduced and hand function for doing daily activities were improved after the treatment. This study clearly indicated that OT treatment was very effective for reducing pain and improving hand function of patients with CTS. A similar study was conducted by Jensen et al (2006) with 40 participants with CTS and treatment provided within 4-5 weeks and found that OT treatment is very effective for patients with CTS. In this study researcher found that OT treatment for CTS was effective for reducing patient's pain.

## **CHAPTER 6 LIMITATION**

It was the first study in Bangladesh, so there were some limitations and barriers during conducting the research project. They are as Follows: In this study the researcher used one experimental group which acted their own control group. The research would explore more accurate information if there were a control group of participants (Hicks, 1999).

However, in the study settings, this study's need to long time but study was done in shorter time; this study was use 9 participants to evaluate the effectiveness of hand therapy intervention for CTS patients. This was very small number of participants that is why it is not possible to generalize the study's result in carpal tunnel syndrome patients. No financial support was given for conducting this study projects this is why not possible to move any other hospital to gather much more participants. In this study the participant get only 4 weeks treatment sessions due to lack of time limitation. Though the treatment was effective but it could not check the long term effect.

It was very difficult to keep confident the aim of the study for blinding procedure. There was no available research done in this area in Bangladesh. So, as a result in the Bangladesh Health Professions Institute (BHPI) library, there were no relevant data found in this area and relevant information about Carpal tunnel syndrome and occupational therapy treatment of hand is very limited. Due to lack of number of the participants the external validity of the study decreased, and there might be lack of agreement about distributing of confounding variables e.g. socio-economic status, age, time of onset and severity of the condition. These unmeasured variable were not controlled in the analysis might have affect the outcome.



## **CHAPTER 7 RECOMMENDATION**

By conducting this study the researcher found significant result about the effectiveness of hand therapy intervention for CTS patients. Significant result for reducing pain, increase range of motion, and improve muscle strength, improved hand function were found by occupational therapy treatment program for the patients with CTS of hand.

But following things should be done in future; this study should be conducted with longer duration to evaluate long term effectiveness of hand therapy intervention for CTS patients. It is suggested to include an occupational therapy treatment program in rehabilitation program of CTS patients to provide better service. Because it is a responsibility for all health professional and it should be core component of medical school curriculum. As the consequence of the study, another study should be done with large number of participants so that the result can be generalized for CTS patients in Bangladesh. In future, in this type of study during sample selection randomization should be done And as control group should be taken to compare the effectiveness of hand therapy intervention for CTS patients, so that this treatment can be more evidence based for this kind of the patients.

As exercise it is the most common highly prescribed in occupational therapy intervention, so in future research is need in this area. On the basis of the result, in future this research can be implemented on patients. It will be beneficial for the patients with the CTS. Finally, it is recommended that, it will be valuable if the study was done in other areas of occupational therapy.

## **CHAPTER 8 CONCLUSION**

The rate of education is very poor in Bangladesh, besides Government and non-Government activities in Health sectors are not sufficient, now a day's Government Health policy is yet to meet the demand of the population and different private clinic and hospitals are trying to bring latest medical services in our country.

Most of the people do not know about occupational therapy. But in the other development country occupational therapy is considered as an important treatment. As a developing medical profession, it is the duty of the occupational therapy in Bangladesh should make a strong evidence for practice which will increase strength and improve the skill of the occupational therapy as well as developed our occupational therapy profession.

The result of this study has the effectiveness of occupational therapy treatment program for CTS patients. With further well-controlled double-blinded study could include in assessing effects and efficacy of this treatment program. CTS is a rare condition but may be the causes of chronic pain, decrease functional ability, decrease hand function, decrease Muscle strength of hand, decrease range of motion. If this condition is not properly treated at the acute stage, finally this may turn into disability. Simple safe, inexpensive measures to decrease pain, improve functional ability, improve hand function, and improve Muscle strength of hand, increase range of motion and to improve ADLs are needed. This occupational therapy treatment program for CTS may provide a simple therapeutic measure, which patients can learn to use by themselves, so they would be able reduce some of the burden resulting from CTS. The study examined the effectiveness of occupational therapy treatment program for 4 weeks helpful to reduce pain, improve functional ability, improve hand function, and improves Muscle strength of hand, increase range of motion and to improve ADLs. Because of the above-mentioned limits, this study lacks generalize ability. This study should be replicated and expanded to confirm the validity of findings.

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## APPENDIX

### Appendix 1:

Pretest and post-test data & their differences

**Overall hand function:** Improvement of hand function with treatment program is different between the scores before treatment and after treatment.

Participants	Hand function	Hand function	Differences between pretest and post-test	
	Pretest x1	Post-test x2	d=x1-x2	d <sup>2</sup>
P1	21	28	7	49
P2	21	28	7	49
P3	7	21	14	196
P4	14	21	7	49
P5	21	28	7	49
P6	21	28	7	49
P7	21	28	7	49
P8	21	28	7	49
P9	14	28	14	196
	$\sum x1 = 161$	$\sum x2 = 238$	$\sum d = 77$	$\sum d^2 = 735$
	$\bar{X}1 = 17.89$	$\bar{X}2 = 26.44$		

The 't' formula-  $t = \frac{77}{\sqrt{\frac{9 \times 735 - (77)^2}{9-1}}}$

t=8.315

Calculating the degree of freedom (df) from the formula,

Df = N-1

= 9-1

= 8

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Hand strength:** Improvement of hand strength with treatment program is different between the scores before treatment and after treatment.

Participants	Hand strength Pretest x1	Hand strength Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	3	7	4	16
P2	2	10	8	64
P3	0	10	10	100
P4	1	5	4	16
P5	5	10	5	25
P6	5	10	5	25
P7	8	10	2	4
P8	10	12	2	4
P9	1	10	9	81
	$\sum x1 = 35$	$\sum x2 = 84$	$\sum d = 49$	$\sum d^2 = 335$
	$\bar{X}1 = 3.89$	$\bar{X}2 = 9.33$		

The 't' formula-  $t = \frac{49}{\sqrt{\frac{9 \times 335 - (49)^2}{9-1}}}$

t=6.314

Calculating the degree of freedom (df) from the formula,

Df = N-1  
 = 9-1  
 = 8

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Pinch strength:** Improvement of pinch strength with treatment program is different between the scores before treatment and after treatment.

Participants	Pinch strength Pretest x1	Pinch strength Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	2	5	3	9
P2	3	8	5	25
P3	0	8	8	64
P4	0	4	4	16
P5	3	7	4	16
P6	4	8	4	16
P7	5	10	5	25
P8	5	10	5	25
P9	0	8	8	64
	$\sum x1 = 22$	$\sum x2 = 68$	$\sum d = 46$	$\sum d^2 = 260$
	$\bar{X}1 = 2.44$	$\bar{X}2 = 7.55$		

The 't' formula- $t = \frac{46}{\sqrt{\frac{9 \times 260 - (46)^2}{9-1}}}$

t=8.693

Calculating the degree of freedom (df) from the formula,

Df = N-1

= 9-1

= 8

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Wrist flexion:** Improvement of Wrist flexion with treatment program is different between the scores before treatment and after treatment.

Participants	Wrist flexion Pretest x1	Wrist flexion Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	30	70	40	1600
P2	35	60	25	625
P3	20	50	30	900
P4	20	40	20	400
P5	45	70	25	625
P6	40	60	20	400
P7	30	50	20	400
P8	40	60	20	400
P9	20	50	30	900
	$\sum x1 = 280$	$\sum x2 = 510$	$\sum d = 230$	$\sum d^2 = 6250$
	$\bar{X}1 = 31.111$	$\bar{X}2 = 56.67$		

The 't' formula-

$$t = \frac{230}{\sqrt{\frac{9 \times 6250 - (230)^2}{9-1}}}$$

$$t = 11.240$$

Calculating the degree of freedom (df) from the formula,

$$Df = N-1$$

$$= 9-1$$

$$= 8$$

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Wrist extension:** Improvement of Wrist extension with treatment program is different between the scores before treatment and after treatment.

Participants	Wrist extension Pretest x1	Wrist extension Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	20	50	30	900
P2	20	50	30	900
P3	5	30	25	625
P4	15	30	15	225
P5	35	50	15	225
P6	30	50	20	400
P7	20	40	20	400
P8	30	50	20	400
P9	20	30	10	100
	$\sum x1 = 195$	$\sum x2 = 380$	$\sum d = 185$	$\sum d^2 = 4175$
	$\bar{X}1 = 21.67$	$\bar{X}2 = 42.22$		

The 't' formula-

$$t = \frac{185}{\sqrt{\frac{9 \times 4135 - (185)^2}{9-1}}}$$

$$t = 9.041$$

Calculating the degree of freedom (df) from the formula,

$$Df = N-1$$

$$= 9-1$$

$$= 8$$

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Wrist Redial deviation:** Improvement of Wrist redial deviation with treatment program is different between the scores before treatment and after treatment.

Participants	Wrist Redial deviation Pretest x1	Wrist Redial deviation Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	7	15	8	64
P2	8	15	7	49
P3	5	10	10	100
P4	5	10	5	25
P5	10	15	5	25
P6	10	15	5	25
P7	5	15	10	100
P8	8	15	7	49
P9	5	10	5	25
	$\sum x1 = 63$	$\sum x2 = 120$	$\sum d = 77$	$\sum d^2 = 462$
	$\bar{X1} = 7.00$	$\bar{X2} = 13.33$		

The 't' formula-

$$t = \frac{77}{\sqrt{\frac{9 \times 462 - (77)^2}{9-1}}}$$

$$t = 10.539$$

Calculating the degree of freedom (df) from the formula,

$$Df = N-1$$

$$= 9-1$$

$$= 8$$

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)

**Wrist Ulnar deviation:** Improvement of Wrist ulnar deviation with treatment program is different between the scores before treatment and after treatment.

Participants	Wrist Ulnar deviation: Pretest x1	Wrist Ulnar deviation: Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	10	25	15	225
P2	10	20	10	100
P3	5	8	3	9
P4	5	10	5	25
P5	10	20	10	100
P6	10	20	10	100
P7	10	20	10	100
P8	10	20	10	100
P9	5	10	5	25
	$\sum x1 = 75$	$\sum x2 = 153$	$\sum d = 78$	$\sum d^2 = 784$
	$\bar{X}1 = 8.33$	$\bar{X}2 = 17.00$		

The 't' formula-

$$t = \frac{78}{\sqrt{\frac{9 \times 784 - (78)^2}{9-1}}}$$

$$t = 7.076$$

Calculating the degree of freedom (df) from the formula,

$$Df = N-1$$

$$= 9-1$$

$$= 8$$

Six numbers of critical values of 't' =

1.833      2.262      2.822      3.250      4.297      4.780

P value: P<0.005 (or 0.5)



**Pain interfering daily living activities:** Improvement of pain in resting position with treatment program is different between the scores before treatment and after treatment.

Participants	Pain in resting position:Pretest x1	Pain in resting position:Post-test x2	Differences between pretest and post-test	
			d=x1-x2	d <sup>2</sup>
P1	9	1	8	64
P2	8	0	8	64
P3	10	1	9	81
P4	10	4	6	36
P5	5	0	5	25
P6	8	0	8	64
P7	9	2	7	49
P8	5	1	4	16
P9	8	2	6	36
	$\sum x1 = 72$	$\sum x2 = 11$	$\sum d = 61$	$\sum d^2 = 435$
	$\bar{X}1 = 8.00$	$\bar{X}2 = 1.22$		

The 't' formula-

$$t = \frac{61}{\sqrt{\frac{9 \times 435 - (61)^2}{9-1}}}$$

$$t = 12.387$$

Calculating the degree of freedom (df) from the formula,

$$Df = N-1$$

$$= 9-1$$

$$= 8$$

Six numbers of critical values of 't' =

1.833

2.262

2.822

3.250

4.297

4.780

P value: P<0.005 (or 0.5)

## Appendix 2

### Treatment protocol for carpal Tunnel syndrome:

Carpal Tunnel assessment form is to be completed prior to commencing conservative treatment.

#### Week 0-6:

- A wrist immobilization splint is fitted in a neutral wrist position. Provide cock-up splint. If ill-fitting a plastic wood wrist brace will need to be fitted. If well-defined lumbricals are evident, a splint extending the MCPs should be fabricated to prevent lumbrical migration into the carpal tunnel whilst at rest. (Hardman, 2011).

#### Neutral wrist position:



The patient is advised to remove the wrist brace 2 times daily for AROM, to ensure maintenance of joint mobility and to ensure tendon gliding and nerve gliding exercises of the FDP/FDS, ultrasound, carpal bone mobilization for people with CTS.

- **Tendon gliding exercise:** Teach patient tendon gliding exercises to develop mobility in the extrinsic tendons. Such exercises should be performed gently to prevent increased swelling. One of such flexor tendon gliding exercises consists of 5 finger positions. Start off from neutral (straight hand) to hook fist position, then proceed to a full fist, followed by a straight fist and then thumb flexion. (see figure 1). This routine should be done 5 times daily with 5 times repetitive after 2-3 hours as long as the symptoms are not exacerbated. (Rozmaryn, 1998)



- **Median Nerve Mobilization:** Start off with Picture 1 (see figure 2) and progress to each successive position until the median nerve symptoms just begin to be provoked (i.e. tingling, but not to the extent of numbness). Stop at this position, as it is the maximum that the mobilization will go. Sustain position for 5-30 seconds without making the symptoms worse. Alternate between this position and the preceding one. When the patient can be moved into the last position without symptoms, he or she can progress to the next mobilization position and repeat the routine. This routine should be done 3-4 times daily as long as the symptoms are not exacerbated. (Rozmaryn, 1998).



- **Ultrasound:** Ultrasound is normally applied by use of a small metal treatment head which emits the ultrasonic beam. This is moved continuously over the skin for approximately 3-5 mins. Treatments may be repeated 1-2 times daily in more acute injuries and less frequently in chronic cases.( Kerry,2001).
- If edema is present use edema management technique. There are some techniques to reduce edema.
- **Elevation:** For elevation to be effective, the hand must be above the level of your heart. Pillows may be used to elevate the arm and hand at night. During the day keep your hand elevated as much as possible and not swinging at your side.



- **Pumping Exercise:** Hold hand overhead and squeeze fingers together making a fist. This routine should be done after 2-3 hours for 1 minute daily as much as possible.



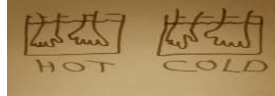
- **Retrograde massage:** Retrograde massage must be performed with the hand elevated. Encircle the swollen area and move from the tip down.
  - Enclose tip of finger with the other hand and slide towards the wrist.
  - For larger areas, massage toward the body in one direction only.
 This routine should be done after 2-3 hours for 1 minute daily as much as possible.



- **Contrast Bathing:** Contrast bath technique to assist with reduction of edema may be issued. This technique should provide warm water for 1 minute and cold water for 1 minute. The patient should be educated to perform this technique 1-2 x as per handout instructions.
  - Two clean containers, large enough to get your hand and wrist into. Bath temperature warm water and ice and cold water.
  - Fill one container with comfortable bath temperature water.
  - Fill the other with cold water and ice.
  - Step 1: Place your hand in the warm water and make 20 hard fists straightening your fingers each time.
  - Step 2: Submerge your hand into the iced water and make 10 hard fists straightening each time.

- Repeat these steps for about 5 minutes and finish in the cold water. (Moore, 1999).

**Contrast bath technique:**



- Patient education on Joint Protection Principles:
  - Respect pain-
    - Signs of pain include fatigue, weakness, stiffness, swelling, aching at night
    - Pain is good guideline that you are doing too much and need to take a break
    - Pain may occur after and not during the activity.
  - Avoid tight excessive or prolonged grip or pinch.
    - Avoid using more force than is actually needed.
    - Choose tools that fit your hand.
  - Use two hands, larger joints and muscles whenever possible
    - Avoid caring heavy items
  - Balance rest and activity.
    - Use splint or other devices to rest joint.
  - Avoid maintaining the same joint position for prolonged periods
  - Reduce excess body weight
  - Use good posture and body mechanics
  - Use the minimum amount of force necessary to complete the job.
  - Simplify work by using efficiency principles: plan, organize, balance work with rest
  - Maintain strength and range of motion
- Patient education on proper body mechanics are to be emphasized:
  - Maintaining wrist in a neutral position
  - Avoiding sustained pinch, grip, particularly with a flexed wrist
  - Avoid repetitive overuse of the wrist.
  - Avoid sleeping with a flexed wrist.

• Patient education on adaptive equipment:

- Utilize ergonomics tools (larger grips etc.)



- Anti-vibration gloves or dampening devices if using machinery



- Proper works station setup if using compute or *Good Office Furniture*, Innovative keyboard designs may reduce hand stress for prolonged periods that Reducing Force from Hand Tools ,provide with workstation handout:



**Key board and Mouse Tips.** Anyone who uses a keyboard and mouse has options that may help protect the hands.

- Adjust the tension of the keys so they can be depressed without excessive force.
- Keep the hands and wrists in a relaxed position to avoid excessive force on the keyboard.
- Replace the mouse with a trackball device and the standard keyboard with a jointed-type keyboard.
- Use wrist rests, which fit under most keyboards, to help keep the wrists and fingers in a comfortable position.
- Keep the computer mouse as close to the keyboard and the user's body as possible, to reduce shoulder muscle movement.
- Hold the mouse lightly, with the wrist and forearm relaxed. New mouse supports are also available that relieve stress on the hand and support the wrist.
- Cut mouse pads in half to reduce movement.
- Taking multiple "micro breaks" (about 3 minutes each) reduces strain and discomfort without decreasing productivity. Such breaks may include the following:
  - Shaking or stretching the limbs
  - Leaning back in the chair
  - Squeezing the shoulder blades together
  - Taking deep breaths

#### **Week 6:**

- Re- evaluation of symptoms using carpal tunnel assessment form
- If improvements noted, it is advised to continue with the program for an additional 1-2 months
- Commence wean out of brace during light tasks. Splint to remain on a nights and for heavy repetitive activities

- Review Hand and Wrist Exercises for the Prevention of Carpal Tunnel Syndrome.

Hand and wrist exercises may help reduce the risk of developing carpal tunnel syndrome. Isometric and stretching exercises can strengthen the muscles in the wrists and hands, as well as in the neck and shoulders, improving blood flow to these areas. Performing the simple exercises described below for 4 - 5 minutes every hour may be helpful.

<b>Exercises for Carpal Tunnel Syndrome</b>	
Wrists	<p>Exercise 1</p> <ul style="list-style-type: none"> <li>• create a loose right fist, palm up, and use your left hand to press gently down against the to close or hold something very tightly hand.</li> <li>• Resist the force with the closed right hand for 5 seconds. Be sure to keep your wrist in a straight line.</li> <li>• Turn your right fist palm down, and press the knuckles against the left open palm for 5 seconds.</li> <li>• Finally, turn your right palm so the thumb-side of the fist is up, and press down again for 5 seconds.</li> <li>• Repeat with your left hand.</li> </ul>
	<p>Exercise 2</p> <ul style="list-style-type: none"> <li>• Hold one hand in a straight line up shoulder-high with your fingers together and palm facing outward. (The position looks like a shoulder-high salute.)</li> <li>• With the other hand, bend the hand you are exercising backward with the fingers still held together and hold for 5 seconds.</li> <li>• increase your fingers and thumb open while your hand is still bent back and hold for 5 seconds.</li> <li>• Repeat five times with each hand.</li> </ul>
	<p>Exercise 3 (Wrist Circle)</p> <ul style="list-style-type: none"> <li>• Hold your second and third fingers up, and close the others.</li> <li>• Draw five clockwise circles in the air with the two fingertips.</li> <li>• Draw five more counterclockwise circles.</li> <li>• Repeat with your other hand.</li> </ul>
Fingers and Hand	<p>Exercise 1</p> <ul style="list-style-type: none"> <li>• Clench the fingers of one hand into a tight fist.</li> <li>• Release, fanning out your fingers.</li> <li>• Do this five times. Repeat with the other hand.</li> </ul>

	<p>Exercise 2</p> <ul style="list-style-type: none"> <li>• To exercise your thumb, bend it against the palm beneath the little finger, and hold for 5 seconds.</li> <li>• Spread the fingers apart, palm up, and hold for 5 seconds.</li> <li>• Repeat five to 10 times with each hand.</li> </ul>
<p>Forearms (stretching these muscles will reduce tension in the wrist)</p>	<p>Exercise 3</p> <ul style="list-style-type: none"> <li>• Gently pull your thumb out and back and hold for 5 seconds.</li> <li>• Repeat five to 10 times with each hand.</li> </ul> <ul style="list-style-type: none"> <li>• Place your hands together in front of your chest, fingers pointed upward in a prayer-like position.</li> <li>• Keeping your palms flat together, raise your elbows to stretch your forearm muscles.</li> <li>• Stretch for 10 seconds.</li> <li>• Gently shake your hands limp for a few seconds to loosen them.</li> <li>• Repeat frequently when your hands or arms tire from activity.</li> </ul>
<p>Neck and Shoulders</p>	<p>Exercise 1</p> <ul style="list-style-type: none"> <li>• Sit upright and place your right hand on top of your left shoulder.</li> <li>• Hold that shoulder down, and slowly tip your head down toward the right.</li> <li>• Keep your face pointed forward, or even turned slightly toward the right.</li> <li>• Hold this stretch gently for 5 seconds.</li> <li>• Repeat on the other side.</li> </ul> <p>Exercise 2</p> <ul style="list-style-type: none"> <li>• Stand in a relaxed position with your arms at your sides.</li> <li>• Shrug your shoulders up, then squeeze your shoulders back, then stretch your shoulders down, and then press them forward.</li> <li>• The entire exercise should take about 7 seconds.</li> </ul>

(University of Maryland Medical Center, 2013).

If no changes in symptoms, the patient is to be referred to orthopedic consultant

(Hardman, 2011).

### Appendix 3

#### Questionnaire (Pre-test and Post-test).

This Questionnaire will develop to measure health state to patients with Carpal Tunnel Syndrome (CTS).

Patient's Name:

Occupation:

Age:

Contact number:

Sex:

Date:

Address:

Components:

1. Hand function.
2. Muscle Strength
3. Range of Motion.
4. Pain

1. Hand function (using Royal air force scale)

	Pretest assessment		Post-test assessment	
	Right	Left	Right	Left
Hook grip:e.g.Carring bag				
Light pinch:e.g. Pick up pencil				
Heavy pinch:e.g.zipper				
Lateral pinch:e.g. key				
Light grip:e.g.holding glass				
Heavy grip:e.g.Full grip				
Opposition:e.g.scissor,button				

2. Muscle Strength of Hand ( Pretest)

Hand strength (Jamar dynamic meter)

Pinch Strength (Pinch Gause)

Date	Score (kg)	
	Right	Left

Date	Score (kg)	
	Right	Left



Post-test:

Hand strength (Jamar dynamic meter)

Date	Score (kg)	
	Right	Left

Pinch Strength (Pinch Gause)

Date	Score (kg)	
	Right	Left

3. Range of motion-(Using Goniometer).Active/passive.

		Pre-test assessment		Post-test assessment	
		Right	Left	Right	Left
wrist	Flexion				
	Extension				
	Redial deviation				
	Ulnar deviation				

4. Pain (using VAS scale).

a. *In which area of your hand, you feel pain?*

- Elbow
- forearm
- Wrist
- Metacarpophalangeal (MCP)
- Proximal interphalangeal (PIP)
- Thumb interphalangeal (IP)

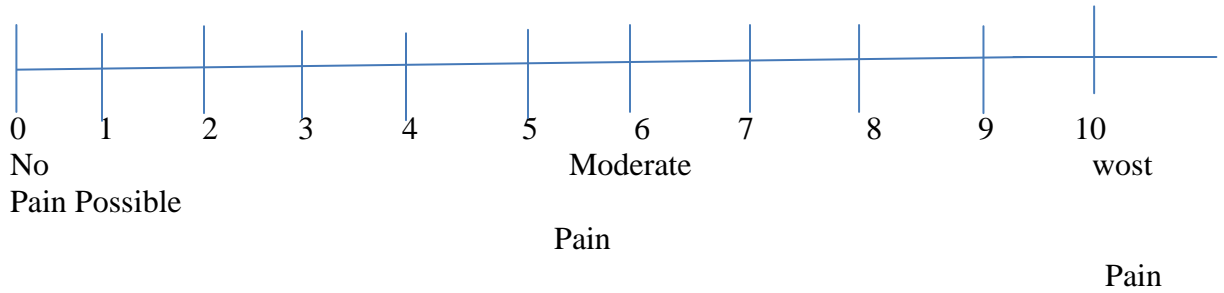
b. *How much have you been suffering from pain?*

Year..... Month..... Day.....

c. How much your pain interferes with your normal everyday activities?

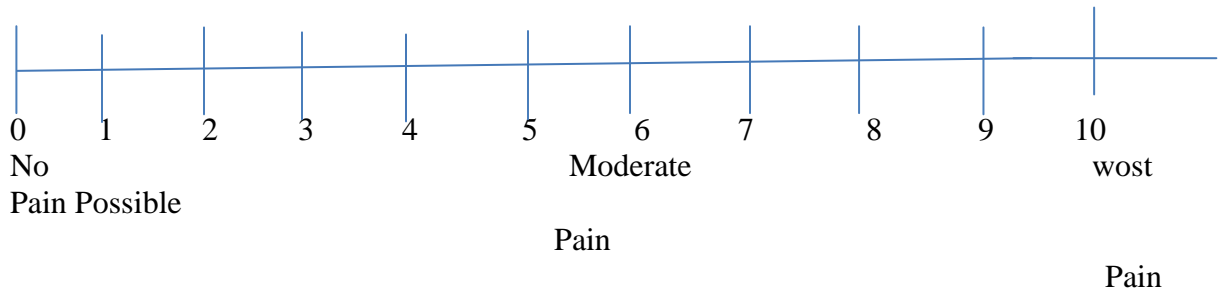
Pretest:

0–10 Numeric Pain Rating Scale



Post-test:

0–10 Numeric Pain Rating Scale



## Appendix 4

### Permission letter for conducting study

#### Approval Letter

23<sup>th</sup> September, 2014  
 The Head of the Department  
 Department of Occupational Therapy  
 Bangladesh Health Professions Institute (BHPI)  
 CRP, Chapain, Savar, Dhaka-1343

**Subject: Application for seeking approval to conduct the study for fulfillment of 4<sup>th</sup> year of B.Sc. in Occupational Therapy course.**

Madam,



With due respect, I want to state that, I am sincerely seeking permission to conduct my research project as the part of my 4<sup>th</sup> year course curriculum. The title of my research is "*Effectiveness of Hand therapy intervention for Carpal Tunnel Syndrome patients at CRP*". The aim of the study is "To identify the effectiveness of treatment protocol for carpal tunnel syndrome". Now I am looking for your kind approval to start my research project and I would like to assure that anything of my project will not harmful for the participants.

So, I therefore hope that you would be kind enough to grant me the permission of conducting the research and help me to complete a successful study as a part of my course.

Sincerely yours,

*Md. Azizul Haque*

**Md. Azizul Haque**  
 4<sup>th</sup> year, B.Sc. in Occupational Therapy  
 Department of Occupational Therapy  
 BHPI, CRP, Savar, Dhaka-1343

Approved by	Signature and comment
<b>Research supervisor</b> <b>Md. Julker Nayan</b> Assistant Professor Department of Occupational Therapy BHPI, CRP, Savar, Dhaka-1343	<i>Proposal seems ok            so he may allow to            conduct the study</i> 
<b>Head of the Department</b> <b>Nazmun Nahar</b> Assistant Professor & Head of the Department Department of Occupational Therapy BHPI, CRP, Savar, Dhaka-1343	<i>As per supervisor's            permission, it may            allow him to conduct            this study.</i>  24.09.14

## Appendix 5

### Information Sheet and Consent Form in English Information Sheet

This research is part of Occupational Therapy course and the name of the researcher is *Azizul Haque*, a student of Bangladesh Health Profession Institute (BHPI) in B.Sc. in Occupational Therapy in 4th year. The study was entitled as “***Effectiveness of Hand therapy intervention for Carpal Tunnel Syndrome patients at CRP***”. And the purpose of this study the effectiveness of treatment protocol for carpal tunnel syndrome.

In this study I am .....  
a participant and I have been clearly informed about the purpose and aim of the study. I will have the right to refuse in taking part any time at any stage of the study. For that reason I will not be bound to answer to anybody. This study has no connection with me and there will be no impact on me and my patient regarding treatment at present and in future.

I am also informed that, all the information collected from the interview that is used in the study would be kept safety and maintained confidentiality. My name and address will not be published anywhere. Only the researcher and supervisor will be eligible to access in the information for his publication of the research result. Your name and address will not published anywhere of this study. I can consult with the researcher and the research supervisor about the research process or get answer of any question regarding the research project. I have been informed about the above-mentioned information and I am willing to participate in the study with giving consent.

Signature/Finger print of the Participant:

Date:

Signature of the Researcher:

Date:

Signature/Finger print of the witness:

Date:

## Appendix 6

### Information Sheet and Consent Form in Bengali

#### সম্মতিপত্র

গবেষনাকারী মোঃ আজিজুল হক হচ্ছে বাংলাদেশ হেলথ প্রফেশনাল ইনস্টিটিউট এর অধীনে, বি,এস,সি, ইন অকুপেশনাল থেরাপী বিভাগের একজন ছাত্র, আমি একটি গবেষণা করতে চাই যে “কার্পাল টানেল রোগীদের জন্য হাতের থেরাপি কতটা কার্যকরী”। গবেষনাকারীর উদ্দেশ্য হচ্ছে, “কার্পাল টানেল রোগীদের জন্য হাতের থেরাপি কতটা কার্যকরী” তা খুঁজে বের করা।

পরস্পর সাক্ষাত এ অংশগ্রহণ করার জন্য, অংশগ্রহনকারীর কাছে থেকে অনুমতি নিচ্ছে গবেষনাকারী। আপনাদের তথ্যগুলো অন্য কারো সাথে আলোচনা করা হবে না। এই গবেষণায় অংশগ্রহনকারীরা কোন ধরনের লাভবান বা ক্ষতির সম্মুখীন হবে না গবেষণার মাধ্যমে। যে সব তথ্য সংগ্রহ করা হবে সাক্ষাত এর মাধ্যমে সেগুলো খুব গোপনীয়তার সাথে রাখা হবে। অংশগ্রহনকারীরা যে কোন সময় এই গবেষণা ছেড়ে চলে যেতে পারবেন।

এই গবেষণায় আমি ..... একজন অংশগ্রহনকারী এবং এই গবেষণার উদ্দেশ্য সম্পর্কে খুব ভালোভাবে জানি। আমি নিজের আগ্রহে এই গবেষণায় অংশগ্রহন করতে চাই। আমার অধিকার আছে যে কোন সময় এই গবেষণার অংশগ্রহন করা থেকে চলে যাওয়ার। এই জন্য আমি আমার উত্তর দিতে দ্বিধা প্রস্তুত নই। গবেষনাকারী গবেষণা সংক্রান্ত যে কোন প্রশ্নের উত্তর যে কোন সময় দিতে প্রস্তুত। সুতরাং আমি আমার সজ্ঞানে এই গবেষণায় অংশগ্রহন করতে ইচ্ছুক।

(যারা লেখাপড়া করতে পারে না, তাদের সামনে পড়ে শুনানো হবে)

অংশগ্রহনকারীর নাম/সাক্ষর .....	তারিখ:
গবেষনাকারীর নাম/সাক্ষর .....	তারিখ:
অংশগ্রহনকারীসাক্ষী / ফিঙ্গারপ্রিন্টনাম ও সাক্ষর:	তারিখ:

