“SHORT TERM EFFECT OF SPENCERS MUSCLE ENERGY TECHNIQUE ON FROZEN SHOULDER PATIENTS ATTENDING AT CRP, SAVAR”

By

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"EFFECT OF SPENCER'S MUSCLE ENERGY TECHNIQUE ON FROZEN SHOULDER PATIENTS ATTENDING AT CRP, SAVAR"

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Declaration

- This work has not previously been accepted in substance for any degree and is not concurrently submitted in candidature for any degree.

- This dissertation is being submitted in partial fulfillment of the requirements for the degree of MSc in Rehabilitation Science.

- This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A Bibliography is appended.

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ACRONYMS AND ABBREVIATIONS

BHPI	Bangladesh Health Professionals Institute
BMRC	Bangladesh Medical Research Council
CRP	Center for Rehabilitation of the Paralyzed
FS	Frozen Shoulder
GH	Gleno Humeral
IRB	Institution Review Board
MET	Muscle Energy Technique
MS	Musculo-skeletal
MWM	Movement with Mobilization
NPRS	Numerical Pain Rating Scale
NSAID's	Non-Steroidal Anti-inflammatory Drugs
P-Value	Probability value
PWD	Person with Disability
RCT	Randomized control trial
ROM	Range of Movement
SD	Standard Deviation
SPADI	Shoulder Pain and Disability Index
SPSS	Statistical Package for Social Sciences
TENS	Transcutaneous Electrical Nerve Stimulation
WHO	World Health Organization

ABSTRACT

Background: Frozen shoulder is the common, idiopathic, self-limiting condition with characterized by severe pain and stiffness on both active and passive shoulder ROM. Spencer muscle energy technique is one of the most commonly used osteopathic manual therapy procedure used in shoulder conditions**.** There are very few studies on the effect of Spencer's muscle energy technique on pain, ROM and shoulder disability in frozen shoulder patients. This study is conducted to find out the actual effect of this technique on frozen shoulder patients.

Method: Participants of aged 25-60 years with frozen shoulder were randomly allocated to experimental and control group (N = 20 each) which received Spencer's MET and conventional treatment of CRP respectively, performed for 4 session. Outcome measures were pain intensity in NPRS, ROM of shoulder and SPADI score which were measured in both groups at two periods [pre and post treatment (immediately after completion of 4 sessions)].

Results: There was a statistically significant reduction in pain intensity with p value 0.000, t=26.1 on paired sample t test in experimental group and p value 0.000, W=-4.06 on Wilcoxon Sign Rank Test in control group. Comparison between groups in Two tailed Mann Whitney U Test indicate experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment in terms of pain intensity in NPRS scale with p value <0.001 and U=82.

There was statistically significant improvement in shoulder flexion, abduction, internal rotation and external rotation ROM in both experimental group and control group on paired sample t test. Comparison between group on Independent sample t test indicate that control group receiving conventional treatment improved much better than experimental group receiving Spencer's MET on shoulder ROM. There was statistically significant improvement in SPADI score in both experimental group and control group on paired sample t test. Comparison between group on Independent sample t test indicate that experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment with p value 0.006 and t=-2.913 in terms of SPADI score.

Conclusion: Both Spencer's MET and conventional treatment protocol has significant results on reducing pain, improving ROM and reducing shoulder disability but when comparing between groups Spencer's MET was more effective on reducing shoulder pain whereas conventional treatment was more effective on improving shoulder ROM.

Keywords: Spencer's MET, conventional treatment, frozen shoulder, ROM, disability, pain.

CHAPTER I
INTRODUCTION

1.1 BACKGROUND

Frozen shoulder is the common, self-limiting condition with uncertain etiology featured by severe pain, stiffness and progressive limitation on shoulder range of motion (ROM) both active and passive without any internal shoulder pathology (Kraal, Beimers, & Van den Bekerom, 2014).

Duplay first identified this condition and termed as periarthrite scapula-humerale. Codman was the first person to coined the term frozen shoulder who defined frozen shoulder as a complex case which is hard to defined, hard to explained and hard to understand its patho physiology. Neviaser studied this condition and observed shoulder joint on arthroscopy. He found that the shoulder joint capsule is tight, thickened; adhere to underlying bone and some capsule stripped off from the bone like adhesive plaster from skin. Then he used the term adhesive capsulitis to define its patho-physiology (Kumar, Kumar, Aggarwal, Kumar, & Das, 2012).

Loyd and loyd define secondary frozen shoulder as a condition resulting from painful spasm on shoulder which causes activity limitation and dependency on opposite arm (Narayan & Vinay, 2014).

In general population, the prevalence rate of frozen shoulder is around 2% to 5% and it ranges from 11% to 30% in diabetic population (Sharma, Baerheim, Moe-Nilssen, & Kvåle, 2016).

Women are affected more than male and approx 70% cases of frozen shoulder are on female. Among all frozen shoulder cases; around 20% to 30% patients develop frozen shoulder on opposite shoulder. Most of the frozen shoulder cases develop on non dominant shoulder.

The exact cause of frozen shoulder is still unknown. Many factors are considered to be associated with frozen shoulder such as Female gender, Age greater than 40 years, Diabetes mellitus, Trauma, Prolonged immobilization, Thyroid disease, Stroke or myocardial infarction, Presence of autoimmune disease and etc (Guldbrandsoy, 2010).

As the capsule is tight, thicken and adhere to bone, it results in painful limitation of both osteokinetic and arthrokinetic shoulder range of motion results in long lasting disorder. The movement restriction happens in capsular pattern as capsule is thicken and shrunken on size. Shoulder external rotation ROM is restricted first followed by shoulder abduction and internal rotation. The shoulder flexion and extension is least affected as most of capsule is thicken and contracture on inferior and anterior aspect of shoulder. Rotator interval and coraco-humeral ligament is also contracted along with inflammation of synovial membrane. (Sharma, Bærheim, Moe-Nilssen, & Kvåle, 2016).

FS is classified based on pathophysiology such as:

1. Idiopathic/primary frozen shoulder

The exact pathophysiology is still unknown. The shoulder joint gradually become stiff and tender, the shoulder muscle develop spasm and it takes long time to fully develop as frozen shoulder. According to some literature, there are 4 distinct stages for diagnosis of FS:

Stage 1: Pre-adhesive stage lasting for 0-3 months

On arthroscopy examination there is fibrinous synovial inflammation characterize by pain and minimal deficit in both active and passive ROM of shoulder resembles impingement syndrome.

Stage 2: Adhesive/freezing stage lasting for 3-9 months

On arthroscopy examination there is synovial inflammation along with reduction on space between capsular fold, humeral head, biceps tendon and glenoid labrum characterized by chronic pain and significant restriction of ROM.

Stage 3: Frozen stage/Maturation stage lasting for 9-15 months, characterized by minimal pain except at end of ROM

Stage 4: Thawing phase lasting for 15-25 months, characterized by minimal pain and significant improvement in ROM (Neviaser & Neviaser, 1987).

1. Trauma/immobilized or secondary frozen shoulder

The condition is associated with trauma, cardiovascular disease, diabetes, hemi paresis and shoulder surgery due to fracture, soft tissue injury which results in prolonged immobilization of shoulder joint. The prolonged immobilization leads to pain, stiffness, spasm and atrophy of shoulder muscles results in frozen shoulders. There is no distinct

phase of development as in primary FS (Guyver, Bruce, & Rees, 2014), (Dundar, Toktas, Cakir, Evcik, & Kavuncu, 2009).

Clinically FS is characterized by gradual onset of shoulder pain and progressive stiffness of shoulder joint results in difficulty in upper limb activity, functional limitation and significant disability. Nocturnal pain is most common symptom in FS causing trouble in sleeping and impossible to sleep on affected shoulder (Russel, 2011).

Symptom of FS gradually changes as day progress. Initially on physical finding, there is tenderness on anterior and lateral gleno-humeral joint line followed by muscle spasm and trigger points in pectoral muscles, trapezius, scapular muscles and deltoid causing pain over shoulder girdle and neck region. In later phase due to significant restriction on shoulder ROM, patients develop compensatory scapula-thoracic motion altering scapular alignment (Guldbrandsoy, 2010).

As the condition progress the pain and stiffness increase further causing immobilization of affected shoulder and form vicious cycle which lead to muscle atrophy on shoulder. Pain stiffness and muscle atrophy causes restriction in activity of daily living and adversely affect quality of life. Thus, it is critically important to diagnosis the condition as soon as possible and to provide optimal treatment before it reaches on advance stage (Alptekin, Aydın, İflazoğlu, & Alkan, 2016).

The exact duration of fully recovery from FS is varies from patient to patients. Some patients fully recover within 18-24 months whereas some need several years. Studies have found that approx 50% of patients experience symptoms of FS even after seven years of onset with functional limitation up to 11%. Around 3% of all European people develop FS during their life span as it is highly associated with insulin dependent diabetes mellitus. With appropriate treatment and rehabilitation intervention, the severity of disability due to FS is markedly reduced on patients (Captuli, 2009).

The exact treatment protocol for FS is still not well established. However, for the management of pain, stiffness and muscle atrophy, several surgical procedure and non-surgical management options are in practice which main aim is to decrease pain and improve ROM. Manual therapy under general anesthesia, arthroscopic capsular release technique, synovectomy, arthroscopic capsular release technique, distension arthrography and supra-scapular nerve block are most common surgical procedure for management of

frozen shoulder. The non-surgical management of FS includes physical therapy, pharmacological treatment includes non-steroidal anti-inflammatory drugs and oral corticosteroids, intra-articular injection includes hyaluronate and steroids; and shoulder joint capsule elongation exercise that aims to decrease pain and inflammation and improve ROM (Oh, 2016).

Physical therapy is often considering the 1st line of treatment option for FS as various exercise and physical therapy modalities help to relief pain, maintain ROM and restore functions (Griggs et.al, 2010).

Cryotherapy, heating modalities, ultrasound (US), transcutaneous electrical nerve stimulation (TENS), interferential therapy, pulsed electromagnetic field therapy, LASER (Light Amplification by Stimulated Emission of Radiations) and Acupunture are the most commonly used modalities to relieve shoulder pain and stiffness (Russel, 2011). The most frequent use exercise in FS includes active and passive ROM exercise, capsular stretching and release technique, stretching and strengthening exercise of shoulder girdle muscles, Codman exercise, Mobilization and Manipulation Techniques and Proprioceptive Neuromuscular Facilitation Technique (PNF), patient education and home exercise (Contractor, Agnihotri, & Patel, 2016).

Muscle energy technique (MET) is a commonly used manual therapy procedure to reduce pain, increase joint ROM by breaking adhesions within joints, releasing muscle tone, stretching the tight muscle and fascia. It also helps to improve muscle strength as it involves the voluntary isometric contraction of desire muscles against resistance provided by therapist. The resistance is provided at pain free physiological barrier and the contraction is hold for 7-10 seconds in precisely controlled direction (Fryer & Ruszkowski, 2004).

It is a form of muscle release technique which is applied before stretching of desire muscles. It works on the basis of autogenic inhibition and reciprocal inhibition. In autogenic inhibition the voluntary isometric contraction of desire muscle within physiological barrier produces post isometric relaxation through activation of Golgi tendon organs. In reciprocal inhibition, the patients have to provide voluntary isometric contraction on antagonist muscles which provide relaxation to agonist muscle and

activation of muscle spindle which leads to reflexive contraction of antagonist muscles (Nambi, Sharma, Inbasekaran, Vaghesiya, & Bhatt, 2013).

Liebenson in 1989 and 1990 describe MET as gentle manual therapy procedure which focus primarily on soft tissues but activation of soft tissue leads to major impact on joint ROM so he termed it as active muscular relaxation technique.

The MET is found to be effective in chronic adhesive capsulitis as it helps in relief pain, increase ROM and improve functional activity because the muscular contraction in specific direction and in controlled position against resistance helps to improve the joint range by improving joint flexibility. This technique is recommended to all joint with restricted ROM (Mohan Kumar et al., 2016).

There are many different forms of muscle energy technique for different muscles and joints based on the clinical condition of patients. Spencer muscle energy technique is latest osteopathic manual therapy procedure widely used in western practice to treat various shoulder conditions. Primarily it was developed and used by C.H. Spencer in 1916 to treat nonsurgical soft tissue injuries in many outpatients clinical setting to improve ROM, decrease pain, improve function in shoulder conditions and many somatic dysfunctions by providing slow stretching to shoulder joint within available ROM. Later it includes several multistep muscle energy technique such as post isometric contraction and relaxation in shoulder joint and rotator cuff muscles to improve shoulder mobility and flexibility (Curcio et al., 2017).

It includes seven different articulation technique especially design for glenohumeral and scapula thoracic joints restriction on patients due to frozen shoulder. To stretch the contracted muscles, ligaments and joint capsules, smooth, rhythmical, passive couple with active muscular contraction is required. This technique enhances the pain free range of motion of shoulder joint on frozen shoulder patients by increasing blood circulation on shoulder joint, enhances lymphatic flow and stretch the muscle, ligaments and capsule of shoulder joint.

Recently many health care medical professionals in professional sports used this technique during training sessions to enhance the performance of athletes in different sports (J.A. Tuck, DO, written communication, August 2016).

It includes different low velocity, moderate to high amplitude technique to reduce shoulder restrictions due to soft tissue injuries, adhesive capsulitis, hypertonic shoulder muscles, traumatic and degenerative injuries in shoulder were improving ROM and decreasing pain are primary concern. It includes both active and passive technique where the active technique includes springing motion or concentric motion against resistance throughout physiological barrier (Nicholas & Nicholas, 2008).

1.2 JUSTIFICATION OF THE STUDY

Frozen shoulder is the common, idiopathic, self-limiting condition with annual incidence 1-3% in a global community. It is characterized by severe pain and stiffness on both active and passive shoulder ROM. Progressive pain and stiffness lead to trigger point on trapezius, deltoid, rotator cuff and scapular muscles. It leads to restriction of upper limb activities. It is more common on female than male and incidence is 30% in diabetic patients.

Physical therapy is often considering the 1st line of treatment option for FS as various exercise and physical therapy modalities help to relief pain, maintain ROM and restore functions.

Spencer muscle energy technique is latest osteopathic manual therapy procedure commonly used in western clinical practice to treat different shoulder conditions. Recently it is used to reduce pain, increase joint ROM by breaking adhesions within joints, releasing muscle tone, stretching the tight muscle and fascia.

There are very few studies on spencer's muscle energy technique. The research relating actual effect of Spencer's MET on pain, ROM and shoulder disability in frozen shoulder patients is very limited. This study is conducted to find out the actual effect of this technique on frozen shoulder patients. Our main aim is to identify the effects of Spencer's MET in frozen shoulder patients in Bangladesh and try to identify whether this technique can be used as treatment option for frozen shoulder patients or not in CRP, Savar.

AIM OF THE STUDY

The study main aim is to compare the short-term effect of Spencer's muscle energy technique with conventional treatment protocol in improving shoulder ROM and decreasing shoulder pain and disability on frozen shoulder patients attending at CRP.

1.3 RESEARCH HYPOTHESIS

Null hypothesis (Ho):

There is no significant difference on improving shoulder ROM and decreasing shoulder pain and disability between Spencer's muscle energy technique and conventional treatment protocol on frozen shoulder patients attending at CRP.

Alternate hypothesis (Ha):

There is significant difference on improving shoulder ROM and decreasing shoulder pain and disability between Spencer's muscle energy technique and conventional treatment protocol on frozen shoulder patients attending at CRP.

1.4 OPERATIONAL DEFINATION

Frozen shoulder: Frozen shoulder is a common, self-limiting condition in which there is restriction of range of motion of shoulder join due to pain resulting from contracture of shoulder joint capsule.

Spencer's MET: Spencer's MET is one of the osteopathic manual therapy procedures used to reduce pain, improve ROM and break restrictions within joints, soft tissues and muscles. It is based on post isometric contraction and relaxation principle where voluntary contraction of desire muscles against resistance help to restore particular joint ROM. It is used in both active and passive form and applicable for all joints.

Conventional Physiotherapy: It is the therapeutic technique which is most commonly used and practiced by clinical physiotherapist in CRP to treat frozen shoulder patients. The most commonly used therapeutic interventions are capsular stretching, shoulder mobilization, pulley exercise, ladder exercise, pendulum exercise, IRR and ROM exercise.

Pain: Pain is an unpleasant sensation or distressing feeling caused by actual or potential tissue damage.

Range of motion (ROM): ROM is the measurement of the amount of movement around a specific joint or body part.

Disability: Disability is any condition that makes it more difficult for a person to do certain activities or interact with the world around them.

CHAPTER II

LITERATURE REVIEW

Frozen shoulder or Adhesive capsulitis is a clinical condition characterized by an insidious and progressive loss of active and passive range of motion of gleno-humeral joint, presumably due to the capsular contraction (Owens, 1996).

It is characterised by severe pain on shoulder movement, stiffness and functional disability of upper limb in which limitation of movement and functional disability is due to pain and shoulder stiffness. The shoulder movement is restricted in capsular patterns such as external rotation is restricted more than shoulder abduction and followed by shoulder flexion. Literature suggest that female have higher chance to develop frozen shoulder than male i.e. 70% female are affected but male are at more risk of longer recovery and physical disability compare to female. Aetiology of FS is classified on two sub categories based on literature. The "primary" or idiopathic FS is characterised by unknown origin resulting in chronic inflammatory changes and fibroblastic proliferation on shoulder joint capsule causing capsular constriction and limitation on shoulder movements. The "secondary" FS results from underlying shoulder injury, post fracture complication, surgeries, shoulder pathology such as rotator cuff injury and other precipitin conditions such as diabetes, CVA, stroke complication, cardiovascular disease, thyroid problem etc (Kirkley et al.,2005). Recent study also indicates that the prevalence of FS is 1:1 ration on both male and female gender (Bunker, 2009).

The prevalence of FS in regional community-based survey was found around 3.6%. It is more common on diabetic patients when compare to non-diabetic patients with estimate prevalence of 11-30% in diabetic population (Smith et al, 2003), (Mavrikakies et al., 1989).

Treatment of FS is classified into three clinical stages such as acute/painful/freezing stage, stiffness/frozen/adhesive stage and recovery/thawing stage. Freezing stage is characterised by gradual onset of pain at rest and sudden sharp pain at night and shoulder overhead movement which lasts for 3-9 months. Frozen stage is characterised by restriction of shoulder motion on capsular pattern with gradual subside of pain on rest. Pain only occurs at extreme shoulder overhead movement. This stage last for 4-12 months. Thawing

stage is characterised by gradual improvement on shoulder ROM, and resolving shoulder stiffness and pain which lasts from 1-3.5 years (Writh et al., 2011) (Thomas et al., 2007).

The mean ROM in frozen stage of FS patients is 98º of abduction, 117 º of flexion, 33 º of internal rotation and 18 º of external rotation. It is considered the longest phase where there is alteration on shoulder complex musculature. The upper trapezius is activated more than lower trapezius results in elevation and upward rotation of scapula during overhead movement of shoulder joint which further limit shoulder ROM. They develop characteristic "shrug sign" on GH overhead movement or shoulder elevation. The muscular imbalance on upper and lower trapezius is shown on EMG study while studying on asymptomatic patients and FS patients (Thomas et al., 2007) (Morrison et al., 2005).

The muscular imbalances in frozen stage results in alteration and deviation of posture such as anterior shoulder or increase thoracic kyphosis curvature results in further limitation on shoulder ROM, pain and stiffness on shoulder, neck and upper thoracic region. The shoulder joint capsule and ligament becomes shorten, fibrosis and contracture results in limitation of further ROM. It also results in fascia restriction, muscular tightness and trigger point which contribute on pain on shoulder movement (Ludewig &Reynolds et al., 2009) (Thomas et al., 2007).

Physical therapy intervention such as mobilization and exercise is considered the most effective treatment for FS. Non-aggressive physical therapy intervention is more effective than aggressive physical therapy interventions on reducing pain and improving ROM (Roubal et al., 2012).

The most appropriate evidence-based physical therapy interventions for FS are pain relief modalities, manual therapy techniques and therapeutic exercises (Bunker & Anthony., 2005).

Research has shown that pain relief modalities such as ultrasound, massage, iontophoresis and phonophoresis have not been beneficial on FS patients. The deep heating modalities such as TENS was found to be more effective than heat combine with exercise and manipulation on FS patients (Bal et al., 2008).

Study conducted by McNeely et al., (2008) concluded that deep friction massage (Cyrax method) and soft tissue mobilization is beneficial for FS patients. Cyrax deep

friction massage was superior on reducing pain and improving ROM than superficial heat and diathermy on FS patients.

Active assisted ROM exercise is the most frequent prescribed exercise on FS rehabilitation. It includes using unaffected limb or some resistance in the form of weight cuff/dumbbell or in the form of equipments such as rope and pulley, wall ladder, T-bar, exercise ball and wand. This exercise is performed for movement which are restricted most such as flexion, abduction, external rotation and internal rotation on the basis of FITT principal (Kazemi., 2009).

Grigges and his colleagues (2010) conducted a study on 77 stage II idiopathic adhesive capsulitis patients to find out the effect of nonoperative treatment on prospective functional outcome. They used four directional shoulder stretching programme such as passive flexion stretching, horizontal adduction stretching, internal rotation stretching behind the back with the help of unaffected arm and external rotation stretching with the help of cane for at least twice a day. They use pain score, ROM and shoulder functions such as DASH questionnaire and SF-36 health survey as outcome measures and concluded that there was a significant improvement on shoulder pain, ROM and shoulder functions among which 64 (90%) patients were satisfied with treatment and only 10% were not satisfied with treatment despite significant improvement on pain score.

A randomized control trial was performed by Paul A et al in frozen shoulder patients. He used sustained stretching of inferior capsule as treatment technique to find its effectiveness in frozen shoulder patients. He randomly assigned 100 participants to an experimental group and control group, 50 participants in each group. He gave physiotherapy treatment and counter traction as a treatment technique in experimental group whereas only physiotherapy treatment in control group. Treatment was provided for 20 min a day for 5 days per week for 2 weeks. He used shoulder ROM, Oxford shoulder score and VAS as outcome measures and found that experimental group receiving shoulder counter traction along with physiotherapy treatment improved much better than control group receiving physiotherapy treatment in terms of shoulder ROM, functional activity and shoulder pain.

Kumar and colleagues (2012) conducted a study on effectiveness of Maitland mobilization on idiopathic adhesive capsulitis patients. He recruited 20 patients in

experimental group and gave maitlamd mobilization techniques such as glenohumeral caudal glide and its progressions, glenohumeral postero-anterior glide and supervised exercise for 12 sessions (4 weeks) and 20 patients in control group. Control group received supervised exercise such as Codman exercise, shoulder wheel exercise, wall ladder exercise and self-stretching exercise. He used pain score, SPADI score and ROM (shoulder abduction and external rotation) as outcome measures and concluded that Maitland mobilization technique in addition to supervised exercise was more effective compare to control group receiving supervised exercise in terms of shoulder pain, shoulder ROM and shoulder functions in adhesive capsulitis patients.

The evolution of Spencer's technique which is often considered as a part of osteopathic manipulative technique was given by Patriquin DA. Spencer technique was developed as a series of techniques directed at shoulder problems. It is said to be a good tool for prognosis establishment in individuals with shoulder dysfunction (Patriquin DA, 1992).

Russell Gambler, DO Shane Holland (2005) termed the Spencer's technique is a cost effective osteopathic technique for range restricting shoulder problems. For long term chronic rehabilitation care, patients have to invest huge amount of cost for it. As Spencer's technique is effective technique, patients have to invest little costs for its long term chronic rehabilitation.

Shubrook J H et al. found that the Spencer's technique was very effective in increasing overall range of motion of shoulder in elderly patients having adhesive capsulitis along with type 2 diabetes mellitus.

An intervention study was carried out by Contractor ES et al in frozen shoulder patients to find the actual effect of Spencer Muscle Energy Technique on pain and functional disability. Subjects within the age range of 40-65yrs and with frozen shoulder were selected based on inclusion and exclusion criteria. Subjects were divided into 2 groups, case and control receiving conventional treatment along with Spencer's MET and conventional treatment respectively. He specified few treatment approaches as conventional treatment such as SWD in capacitor field method for 20 minutes, Codman's Exercises, Rope and Pulley, Wall and Ladder Exercise, Shoulder Wheel Exercise, Self-Stretching Exercise. Treatment was provided for 4 weeks, 3 days/week and once a day.

Data was collected prior to treatment and post treatment after 4 weeks. VAS and SPADI was used as outcome measures. He found that both treatment technique had significant improvement (p=0.05) in terms of VAS and SPADI. He also concluded that experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment in terms of SPADI.

A randomized controlled trial was performed by Knebl JA to find the improvement of Spencer's technique in terms of functional ability in the elderly patients having shoulder problems. 29 patients with shoulder problems which include chronic shoulder pain and stiffness, restricted shoulder ROM, limitation on daily functional activities of shoulder were selected as subjects. Participants were divided randomly into intervention group or control group equally. Intervention group received spencer MET and placebo treatment was given to individuals in control group. Spencer technique without administration of isometric muscle contraction was considered as placebo treatment. Both group received treatment two times per week in 2^{nd}, 4^{th} and 6^{th} week followed by follow up treatment after 1 month (10^{th} week and 14^{th} week). Each treatment session lasted for approximately 30 minutes. Goniometer was used to measure both active and passive ROM of the shoulder joint. Modified physical functioning scale was used to measure physical functioning of participants in terms of need for assistance and the degree of difficulty in performing functions such as dressing, bathing, and grooming. Subjective Units of Discomfort Scale (Achterberb and Lawlis, 1984) was used as measurement tools to measure perceived pain. It is a 10-point rating scale 0 to 10 where 0 indicate no pain and 10 indicate intolerable pain. Result showed that both the groups improve significantly in terms of improving shoulder range of motion and decreased perceived pain during the course of treatment. He concluded that improvement in terms of shoulder ROM in intervention group was more significant and continue than control group receiving placebo treatment.

An experimental study was conducted by Narayan and his collegues (2014) in frozen shoulder patients. He used MET as treatment technique to find its effects on functional ability of shoulder. 30 patients of both genders were recruited into experimental group and control group based on inclusion and exclusion criteria by convenient random sampling method. MET for shoulder flexion, abduction and external rotation along with conventional treatment was applied in experimental group for 15 weeks, thrice per week,

1 session per day in 3 repetitions. The control group received conventional treatment which includes ultrasound, hot packs, Codman's exercise, pulley exercise and active assisted exercise. He found both gender show significant difference and improvement on shoulder pain and disability score after treatment and whereas experimental group shows significant improvement than control group. He concluded MET is much more effective on improving shoulder functions in adhesive capsulitis patients.

A randomized controlled trial was conducted by Reddy in stage II adhesive capsulitis patients to compare the effect of MET with conventional treatment. 40 patients of both genders with age group 40 and above were randomly assigned on experimental and control group based on inclusion and exclusion criteria. Group A received conventional treatment which includes hot pack, TENS and shoulder mobility exercise whereas group B received MET for 5 repetition per set, 3 sets per session and 1 session per day for 15 sessions along with conventional treatment. He used VAS, shoulder flexion, abduction and external rotation ROM and DASH scale as outcome measures. He found both groups show significant improvement ($p<0.0001$) on pain, ROM and shoulder functions and concluded that both treatments are effective in reducing pain, improving ROM and shoulder functions.

A comparative study was conducted in 2019. He used MET and Maitland mobilization coupled with ultrasound as treatment techniques to measure its effects in patients with periarthritis shoulder. 20 male patients within age group 35-50 were recruited into experimental group and control group based on inclusion and exclusion criteria. Group A receive MET for shoulder flexion, abduction and external rotation coupled with ultrasound and group B received Maitland grade IV mobilization for flexion, abduction and external rotation coupled with ultrasound 45 minutes per session for 45 days. He used SPADI as outcome measures. He found that there is significant improvement in post-test value when ultrasound coupled with MET than with Maitland mobilizations and concluded that MET is more significant and superior technique than Maitland mobilization technique in terms of reducing pain and improving functional activities.

Sheikh conducted an experimental study to find the effectiveness of MET and specific inferior capsular stretching in frozen shoulder patients. He recruited 30 patients of both genders within age group 40-70 in experimental and control group, 15 in each group. Group A received hot pack, ultrasound MET and inferior capsular stretching whereas group

B received hot pack, ultrasound and MET for 4 weeks, 5 sessions per week. He used VAS, shoulder ROM and SPADI as outcome measures and found that there is extreme significant improvement in both group. He concluded that the MET and inferior capsular stretching have significant improvement on SPADI, VAS and shoulder ROM clinically and statistically.

Riddle DL et al, reported that on inter-tester reliability measure of goniometric, the PROM measurements for the shoulder appear to be highly reliable than AAROM measurement regardless of the size of the goniometer used. He concluded that the inter tester reliability of any particular goniometer is specific to range of motion rather than its size.

A study conducted by Boone and coworkers evaluated the reliability of goniometer to measure active lateral rotation ROM for shoulder complex. Universal goniometers were used by 4 therapists to measure the ranges in 12 healthy males once a week for 4 weeks. He found that lateral rotation of the shoulder was more reliable than the other movements of shoulder. Authors revealed that intratester reliability was superior than intertester reliability for all the movements other than lateral rotation. There was excellent intratester and intertester reliability for lateral rotation of shoulder with Pearson's correlation coefficient (*r*) of 0.96 and 0.97, respectively.

Shin and co-workers conducted a reliability of shoulder ROM using a smart phone and universal goniometer. 41 adult patients with shoulder dysfunction were included for the study. Intratester reliability of both the devices, for all the movements were found to be excellent by all the three testers (2 orthopedic residents and one orthopedic surgeon) with ICC valuesgreater than 0.92. Intertester reliability of both devices for all the movements were satisfactory, with ICC values greater than 0.70, except for medial rotation, which was 0.63to 0.68 in both the devices. These differences were seen due to the varying amounts of scapula motion control during medial rotation. Between both the devices, a fairly high positive correlation (ICC 0.72 to 0.97) was obtained, but the 95% LOA ranged from 10 to 40 degrees.

Kolber and Hanney performed a study to find the reliability and concurrent validity of shoulder mobility measurements. He used digital inclinometer and universal goniometer to

measure shoulder mobility. They found good correlation for shoulder flexion and abduction (ICC = 0.86, 0.85) and excellent correlation for medial and lateral rotation (ICC = 0.95, 0.97).the mean difference obtained between the digital inclinometer and universal goniometer ranged from 1 to 8 degrees and 95% LOA ranged from 2 to 20 degrees.

Mac Dermid and colleagues conducted the study to measure reliability and validity of passive shoulder rotation ROM in 34 patients with a variety of shoulder dysfunction. Lateral rotation with the shoulder in 20 to 30 degrees of abduction was measured using universal goniometer. Intratester ICCs (0.88 and 0.93) and intertester ICCs (0.85and 0.80) were high. Good reliability was seen in the Intratester standard errors of measurement (SEM; 4.9 and 7.0 degrees) and intertester SEM (7.5and 8.0 degrees).

Roy JS et al. conducted a systematic review to find out the psychometric properties of 4 outcome measurement scale of shoulder disability. He used Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, the Shoulder Pain and Disability Index (SPADI), the American Shoulder and Elbow Surgeons (ASES) score, and the Simple Shoulder Test (SST) for this study. The included studies predominantly suggested that there is excellent reliability in all 4 shoulder disability scales with value ICC> or =0.90. He concluded that Reliability coefficient of SPADI was ICC $\geq$ 0.89 with Internal consistency is high with Cronbach α typically exceeding 0.90

The construct validity of SPADI is good when compare to other region specific shoulder questionnaires. It shows good correlation with other shoulder questionnaire and shows good response over time, in different patient population and different clinical setting. It shows good response and discriminates well in both improving and degrading condition of particular patients. Thus, I choose to use the SPADI (pain score, disability score and total score), the NPRS (pain intensity score) and ROM as outcome measurements for this RCT.

CHAPTER III

RESEARCH METHODOLOGY

3.1 CONCEPTUAL FRAMEWORK:

INDEPENDENT VARIABLES

Socio-demographic variables:

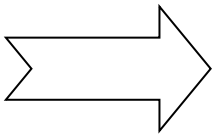
(Age, Gender, Marital status, Education level, Occupation, Religion, Living area, Monthly family income, Duration of problem, Site, Diabetes, surgical history)

Pain variables:

(Worst level of pain, lying on involved side, reaching for something on a high shelf, touching the back of neck, pushing with involved arm)

Disability variables:

(Washing hair, washing back, putting on an undershirt or jumper, putting on a shirt that buttons down the front, putting on pants, placing an object on a high shelf, Carrying heavy object of 10 pound, removing something from your back pocket)



DEPENDENT VARIABLES

Shoulder Range of Motion:

- Flexion
- Abduction
- Internal Rotation
- External Rotation

Shoulder Pain and Disability Index:

- Total SPADI score

Numerical Pain Rating Scale (NPRS) Score

3.2 OBJECTIVES OF THE STUDY

3.2.1 GENERAL OBJECTIVES:

- To compare the short-term effect of Spencer's muscle energy technique with conventional treatment protocol in improving shoulder ROM and decreasing shoulder pain and disability on frozen shoulder patients attending at CRP.
-

3.2.2 SPECIFIC OBJECTIVES:

- To evaluate the short-term effect of Spencer's muscle energy technique in improving shoulder ROM and decreasing shoulder pain and disability on frozen shoulder patients attending at CRP.
- To evaluate the short-term effect of conventional treatment protocol in improving shoulder ROM and decreasing shoulder pain and disability on frozen shoulder patients attending at CRP.
- To compare the effectiveness of Spencer's muscle energy technique with conventional treatment protocol in improving shoulder ROM on frozen shoulder patients attending at CRP.
- To compare the effectiveness of Spencer's muscle energy technique with conventional treatment protocol in decreasing shoulder pain and disability on frozen shoulder patients attending at CRP.

3.3 STUDY DESIGN:

The study was done using quantitative, experimental study design. Patients with frozen shoulder with or without diabetes were recruited into experimental group and control group based on convenience of researcher from hospital random data within the given period of time. Data was collected before and after completion of treatment sessions. Also, this study design best suited with the research question under study and meet the objectives of the study.

3.4 STUDY SETTING:

The study populations were sub-acute and chronic frozen shoulder patients with or without diabetes, who attended musculoskeletal department of CRP, savar for the treatment purpose within age group 30 to 70 years.

3.5 PLACE AND SITE OF THE STUDY:

Musculoskeletal department of CRP, savar, Dhaka, was choosen to conduct this research.

3.6 STUDY PERIOD:

This study was carried out for 10 months, extended from august 2019 to may 2020 from the approval of the protocol till final submission of report.

3.7 TREATMENT DURATION:

- 35 minutes for each patient

3.8 TREATMENT SESSIONS:

- sessions for each patient

3.9 SAMPLE SIZE ESTIMATION:

The estimated sample size for this intervention study was 40 among which 20 participants were included in experimental group and 20 were included in control group.

3.10 SAMPLE SELECTION CRITERIA:

3.10.1 Inclusion Criteria:

- Medically diagnose FS by multi-disciplinary team in CRP
- Age range varies from 30 to 70 years
- Genders: Both male and female
- Patients with unilateral or bilateral adhesive Capsulitis
- Subjects with DM
- Pain and stiffness over the problematic shoulder region
- Patients who give consent to apply particular treatment techniques on them

3.10.2 Exclusion criteria:

- Post fracture frozen shoulder
- Post shoulder dislocation complication
- Post reflex sympathetic dystrophy complication which include frozen shoulder
- Frozen shoulder due to post complication of neurological conditions (stroke or spinal cord injury)
- Arthritis which includes osteoarthritis of shoulder joint and rheumatoid arthritis
- Subjects with rotator cuff tears
- Hyper mobility on shoulder joint
- Ligament injuries in shoulder joint
- Fusion or Ankylosis
- Metabolic Bone Disease
- Neoplastic Disease
- Malignancies affecting the shoulder region
- Infective Arthritis

3.11 SAMPLING TECHNIQUE:

The required number of participants was selected from the musculoskeletal department of CRP. Hospital random sampling was used from all frozen shoulder patients who who met the inclusion and exclusion criteria of the study.

3.12 MATERIAL AND MEASUREMENT TOOL:

- Informed consent form
- Information sheet of patients
- Demographic questionnaire
- Shoulder pain and disability index (SPADI)
- Universal goniometer
- Infra-red radiation (IRR) lamp
- Weight cuff
- Couch with bed
- Pen

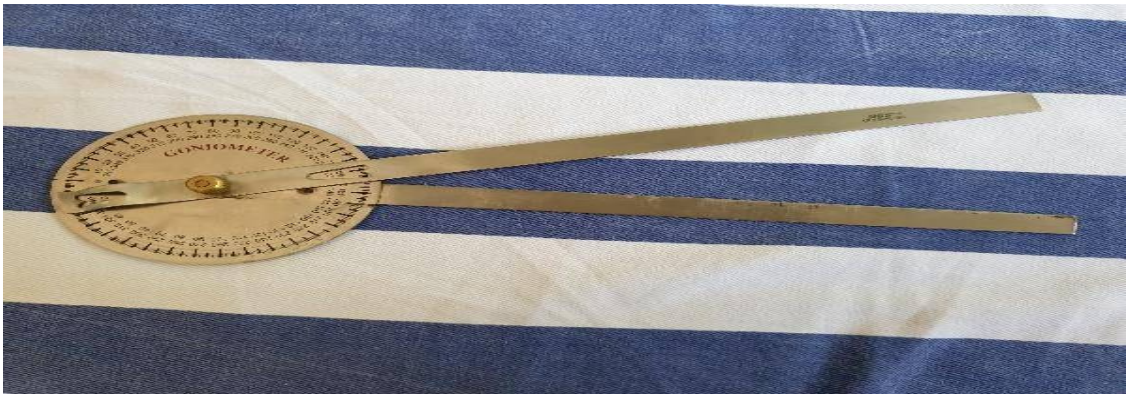


Figure 4.B.2.1 Universal Goniometer

Figure 4.B.2.2: IRR lamp

3.13 PROCEDURE:

Subjects fulfilling the inclusion and exclusion criteria were enrolled for the study. A brief introduction about the treatment procedure was explained to all the subjects. Prior to starting the procedure, a written informed consent (Annexure I) as required by the institutional review board was obtained from the subjects or their guardians. Clinical examination was done on each subject and demographic data regarding age, gender, marital status, education, occupation, religion, living area, monthly family income, duration of problem, site of problem, diabetes and any surgical history was obtained (Annexure II).The subjects were allocated to experimental group (Spencer's muscle energy technique) or the control group (conventional treatment) based on convenience of researcher.

3.13.1 Pre-intervention:

All of the following measurements were done both in experimental and control groups before initiating any treatment protocol:

Patients' socio-demographic information were recorded by administering socio-demographic questionnaire

Shoulder pain intensity and Shoulder disability were measured by using Shoulder Pain and Disability Index (SPADI).

Shoulder pain intensity was measured by using NPRS scale on overhead shoulder movement.

Shoulder range of motion (flexion, abduction, internal rotation and external rotation) was measured using universal goniometer in supine lying position.

3.13.2 Intervention:

In experimental group, Spencer's Muscle Energy Technique was applied for 4 sessions. IRR was given for 10 minutes before administering any MET.

It has 7 stages such as;

1. Extension-Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint and other hand extend the patient shoulder in horizontal plane with elbow on flexed position until end range with barrier was felt. Resistance was provided on

elbow joint and patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier against resistance and maintained the contraction for 8-10 sec. The shoulder joint was returned to neutral position. The same procedure was repeated on new restricted barrier position for 6 to 8 times.

2. Flexion- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint and other hand flexed the patient shoulder in horizontal plane with elbow on extended position until end range with barrier was felt. Resistance was provided on distal forearm and patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier against resistance and maintained the contraction for 8-10 sec. The shoulder joint was returned to neutral position. The same procedure was repeated on new restricted barrier position for 6 to 8 times.

3. Circumduction/compression- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint and other hand abducted the patient shoulder in horizontal plane with elbow on flexed position. Patient elbow joint was used as pivot to rotate humerus clockwise and counterclockwise direction with slight compression on shoulder joint for 15 times each. The circle size of circumduction was gradually increased with each circular motion.

4. Circumduction/traction- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint and other hand abducted the patient shoulder in horizontal plane with elbow on extended position. Patient distal forearm was used as pivot to rotate humerus clockwise and counterclockwise direction with slight traction on shoulder joint for 15 times each. The circle size of circumduction was gradually increased with each circular motion.

5A. Abduction with external rotation- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint while patient grabbed on therapist same forearm and other hand provided resistance on elbow joint for abduction force. Patient has to exert upward (cephalad) pressure on elbow to increase abduction till end range was felt. Patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier

against resistance and maintained the contraction for 8-10 sec. The shoulder joint was returned to neutral position. The same procedure was repeated on new restricted barrier position for 6 to 8 times.

5B. Adduction with external rotation-Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Therapist one hand stabilized the acromioclavicular joint while patient grabbed on therapist same forearm and other hand abduct the arm on 90 degree in horizontal plane and provided resistance on elbow joint for adduction force. Patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier against resistance and maintained the contraction for 8-10 sec. The shoulder joint was returned to neutral position. The same procedure was repeated on new restricted barrier position for 6 to 8 times.

6. **Internal rotation**- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Patient elbow was flexed and hand was positioned on his lower back within available range. Therapist one hand stabilized the acromioclavicular joint while other hand or 2 fingers applied resistance on elbow joint where the arm was in internally rotated position. Patient has to exert forward (anterior) pressure to elbow to internally rotate until end range was felt. Patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier against resistance and maintained the contraction for 8-10 sec. The shoulder joint was returned to neutral position. The same procedure was repeated on new restricted barrier position for 6 to 8 times.

7. **Traction of deltoid**- Patient was in side-lying position with affected shoulder uppermost. Therapist was standing in front of the patient. Patient shoulder and elbow was extended and rested on therapist shoulder. Therapist clasped his hand around patient shoulder and provided downward and upward motion on the deltoid muscles to increase soft tissue motion of deltoid as well as ligament on shoulder joints. It was continued for 30 sec and repeated for 6 to 8 times

.

Figure 3.B.3 Spencer's Muscle Energy Technique

In control group, conventional treatment protocol was applied for 4 sessions and it includes:

- IRR in shoulder joint for 10 minutes
- Capsular stretching on shoulder joint which includes anterior capsule, posterior capsule and inferior capsule and each stretching position was holding for 30 sec and repeated for 3 times.
- Maitland mobilizations which include AP glide, PA glide and superior to inferior glide. Each glide was given for 10 times in each position for 3 sets.
- Pulley exercise for 5 minutes
- Pendular exercise with weight cuff to increase flexion, extension and abduction ROM

3.13.3 Post-intervention:

All of the following measurements were done both in experimental and control groups after completion of 4 sessions:

Shoulder pain intensity and Shoulder disability were measured by using Shoulder Pain and Disability Index (SPADI).

Shoulder pain intensity was measured by using NPRS scale on overhead shoulder movement.

Shoulder range of motion (flexion, abduction, internal rotation and external rotation) was measured using universal goniometer in supine lying position.

3.14 OUTCOME MEASURES:

- Shoulder pain intensity – By NPRS
- Shoulder pain and disability – By SPADI
- Shoulder ROM (flexion, abduction, internal rotation and external rotation) – By universal goniometer

3.14.1 NUMERICAL PAIN RATING SCALE (NPRS):

The NPRS is a self-reported, uni-dimensional pain rating questionnaire which measure of pain intensity in patients. The 11-point numerical scale ranges from '0' representing one pain extreme (e.g. "no pain") to '10' representing the other pain extreme (e.g. "pain as bad as you can imagine" or "worst pain imaginable"). It is segmented numeric version of the Visual Analogue Scale (VAS) in which a respondent selects a whole number (0-10 integers) the best reflects the intensity of his/her pain. The common format is a horizontal bar or line. The NPRS is anchored by terms describing severity extremes.

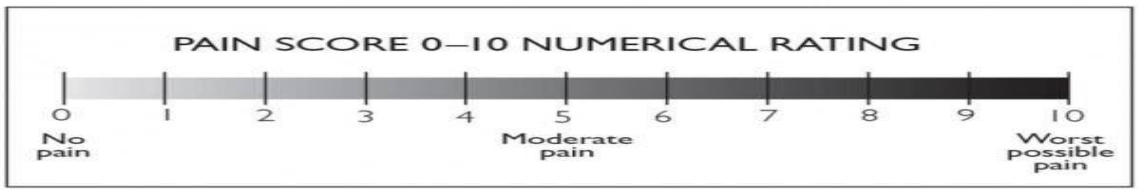


Figure 4.B.4: Numerical Pain Rating Scale

Scoring and interpretation: Scores range from 0-10 points, with higher scores indicating greater pain intensity.

3.14.2 SHOULDER PAIN AND DISABILITY INDEX (SPADI):

The SPADI is a self-administered, condition-specific pain and functional status questionnaire. It consists of two dimensions, one for pain and the other for functional activities. The pain dimension consists of five questions regarding the severity of an individual's pain (At its worst, when lying on the involved side, reaching for something on a high shelf, touching the back of your neck and pushing with the involved arm). Each item is scored 0 to 10 in which zero means 'No pain' and 10 means 'Worst imaginable pain' with the total reported as either a raw score (0–50) or as a percent- age score. Functional activities are assessed with eight questions (washing your hair, washing your back, putting on an undershirt or jumper, putting on a shirt

that buttons down the front, putting on your pants, placing an object on a high shelf, carrying a heavy object of a 10 pounds and removing something from your back pocket) designed to measure the degree of difficulty an individual has with various activities of daily living that require upper- extremity use. Each item is scored 0 to 10 in which zero means 'No difficulty' and 10 means 'so difficult it requires help' with the total reported as either a raw score (0–80) or as a percent- age score The SPADI takes 5 to 10 minutes for a patient to complete and is the only reliable and valid region-specific measure for the shoulder. The scores from both dimensions are averaged to derive a total score.

INTERPRETATION OF SCORES:

Total pain score: ……. /50×100 = %

A higher score indicates more patient-rated pain.

Total disability score: …… /80×100 = %

A higher score indicates more patient-rated disability.

Total SPADI score: …… /130×100 = %

The means of two subscales are averaged to produce a total score ranging from 0 (best) to 100 (worst).

3.14.3 SHOULDER RANGE OF MOTION:

Shoulder joint has various movements namely, flexion, extension, abduction, adduction, rotation (internal and external) and combine movement pattern. A universal goniometer is an instrument which measures available range of motion at a joint. The term “goniometry” is derived from two Greek words, ‘gonia’ meaning ‘angle’ and ‘metron’ meaning ‘measurement’. Amongst different types, the most used is the universal goniometer. It consists of a stationary arm, a movable arm and a fulcrum.

In this study shoulder ROM (flexion, abduction, internal rotation and external rotation) was assessed using a universal goniometer.

Normal values:

- Shoulder flexion = 0 to 180 degree
- Shoulder abduction = 0 to 150 degree
- Shoulder internal rotation = 0 to 90 degree

- Shoulder external rotation = 0 to 90 degree

Shoulder flexion: The patient was in spine lying position with no shoulder abduction, adduction or rotation, forearm in 0 degree of supination and pronation so that the palm of the hand faces the body. The clinician one hand stabilized the scapula to prevent elevation and upward rotation of scapula and other hand flexed the shoulder joint until the first point of resistance. The other clinician placed the fulcrum of goniometer on center of humeral head near acromion process, Stationary arm parallel to the mid axillary line and Movable arm aligned with midline of humerus and recorded the amount of motion by aligning the goniometer with midline of humerus.

Shoulder abduction: The patient was in supine lying position with palm facing upwards and wrist in supination. The clinician one hand stabilized the scapula and other hand abducted the shoulder joint until the first point of resistance. The other clinician placed the fulcrum of goniometer on inferior lateral coracoid process, Stationary arm parallel with the trunk and Movable arm was aligned in the line with the midline of humerus and recorded the amount of motion by aligning the goniometer with midline of humerus.

Shoulder rotation: GH internal and external rotation were measured with the participant lying supine on the examination table, with the shoulder abducted to 90 degrees and the elbow in 90 degrees of flexion. The clinician applied a posterior stabilizing force to the acromion processes of the scapula and internally rotated the arm until the first point of resistance. A second clinician recorded the amount of motion by aligning the digital inclinometer with the shaft of the ulna. GH external rotation motion was collected using the same technique.

All post-test measurements were performed in an identical manner to the pretest measurements

3.15 QUALITY CONTROL AND ASSURANCE:

To ensure and improve the quality of study, the socio-demographic questionnaire, informed consent form and profoma were translated according to WHO guidelines i.e., first in national language Bengali following the standard procedure of linguistic

validation. For language translation, two individuals who were fluent on both Bengali and English languages were assigned for forward translation. They both sat together with their translated version of questionnaire and discussed to finalize the final version of the translated questionnaire. The third individual who was fluent on both languages and had not seen the original version of questionnaire was selected for backward translation. Then all three individuals sat together and discussed. Then the final version of translated questionnaire on Bengali language was finalized.

Before starting data collection procedures, pilot study was conducted for the questionnaire to ensure face validity of the questionnaire with 5 frozen shoulder patients receiving treatment from the musculoskeletal unit, CRP. Before administering spencer's muscle energy technique on frozen shoulder patients, pilot study was conducted on 5 frozen shoulder patients to measure its immediate effect on ROM and pain score. After reviewing the result of pilot study, changes were made in prepared questionnaire and treatment protocol. The pilot study results were kept safely. The collected data were reviewed, recorded and entered into SPSS program to minimize the human errors that are likely to occur while entering and analyzing the data.

3.16 ETHICAL CONSIDERATION:

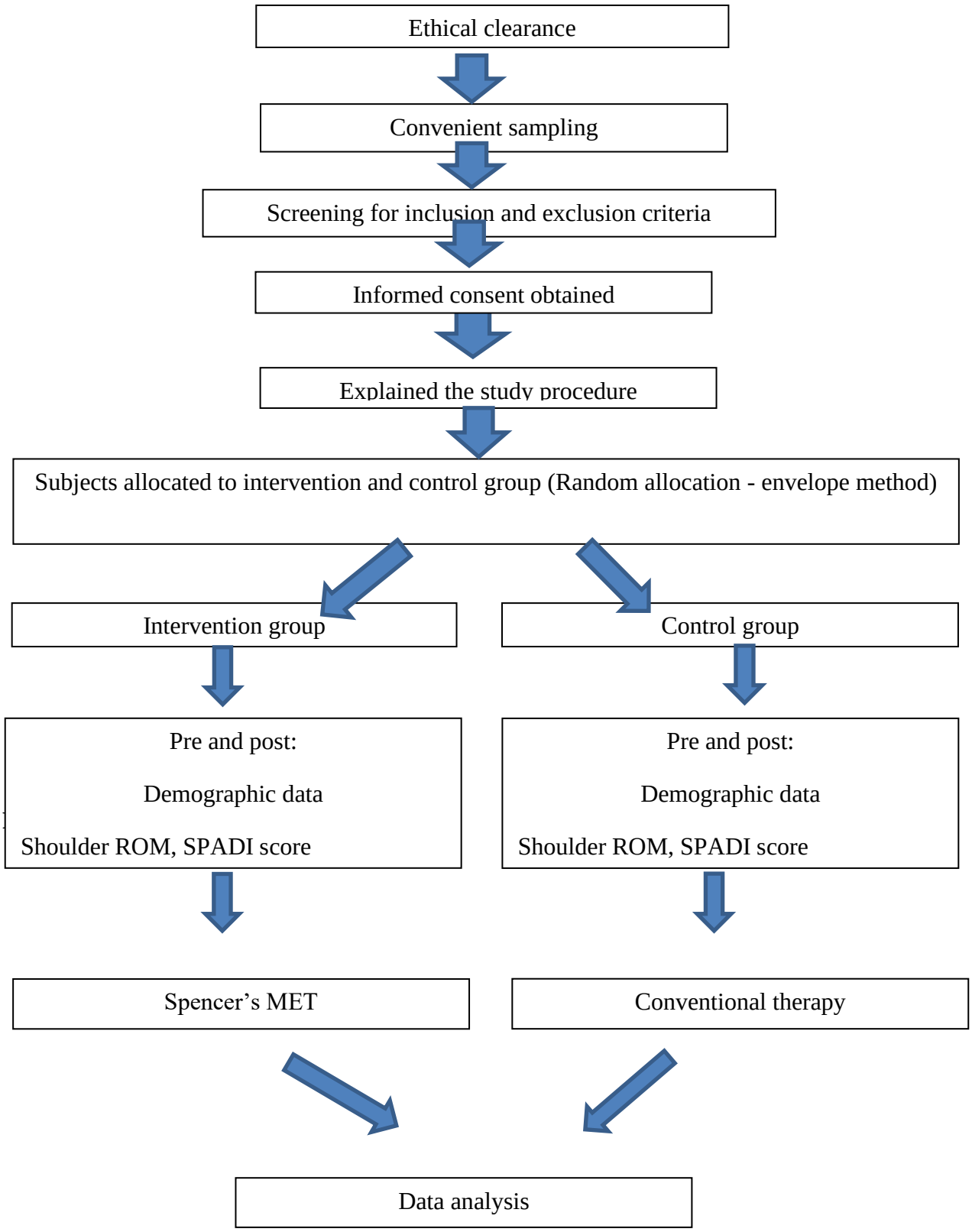
The study was conducted following the standard guidelines of ethical consideration. The study followed the WHO and Bangladesh medical research council (BMRC) guidelines. Firstly, the prepared research proposal was submitted to the concerning authority after getting approval from the course coordinator of Department of Masters in Rehabilitation Science and supervisor. Ethical approval was taken from the Institutional Review Board (IRB) of Bangladesh Health Professions Institute (BHPI) for conduction of research. To finalize the conventional treatment protocol, 10 clinical physiotherapists from musculoskeletal department were selected and requested to submit their common treatment protocol for frozen shoulder patients. Based on the 10 treatment protocol, the conventional treatment protocol was finalized. Then the written application and finalized conventional treatment protocol was submitted to the head of physiotherapy department of musculoskeletal unit, CRP. After obtaining permission from the concern authority, data collection was started.

Prior to data collection, a written informed consent was taken from the respondents. The respondents were informed about complete freedom to leave the treatment or not give the answer if they are not willing to answer any question within the questionnaire. Even the participants were not being forced to answer the questions if they are not willing to provide it. Researcher accepted the answers of participants without any influences. The personal identity and information provided by the subjects were maintained confidential. It is protected by the law "right to privacy" which prevents the researcher from disclosing any direct information about the participants of the research. Similarly, there was not any manipulation, modification and alteration in the collected data from researcher for the purpose to manage the result.

3.17 STATISTICAL ANALYSIS

- The Frequency, percentage, mean and standard deviation was used as Descriptive statistics to study and explain demographic data and variables.
- Microsoft office excel was used to tabulated the data. Statistical Package for Social Science (SPSS) version 21was used to analyze the data by creating SPSS files first followed by data entry into these files. Analysis of data was done by using:
    - Paired sample t-test to find the effectiveness or significance of both treatment technique (Spencer's MET and Conventional treatment protocol) within group for parametric data such as shoulder ROM and SPADI score.
    - Paired sample t-test for experimental group and Wilcoxon Signed ranked test for control group to find the effectiveness or significance of both treatment technique for Non parametric data such as NPRS score.
    - Independent sample t-test to compare the effectiveness or significance of treatment technique between experimental and control group for parametric data such as shoulder ROM and SPADI score.
    - Two tailed Mann Whitney U test to compare the effectiveness or significance of treatment technique between groups for non-parametric data such as NPRS score.

  Statistical package SPSS ver. 21.0 will be used to do the analysis
- For statistically significant results, Probability values (p) should be <0.05.


Ethical clearance
Convenient sampling
Screening for inclusion and exclusion criteria
Informed consent obtained
Explained the study procedure
Subjects allocated to intervention and control group (Random allocation - envelope method)
Intervention group
Control group
Pre and post:
Demographic data
Shoulder ROM, SPADI score
Pre and post:
Demographic data
Shoulder ROM, SPADI score
Spencer's MET
Conventional therapy
Data analysis

CHAPTER IV

RESULT

Figure 4.B.6: participant flow diagram

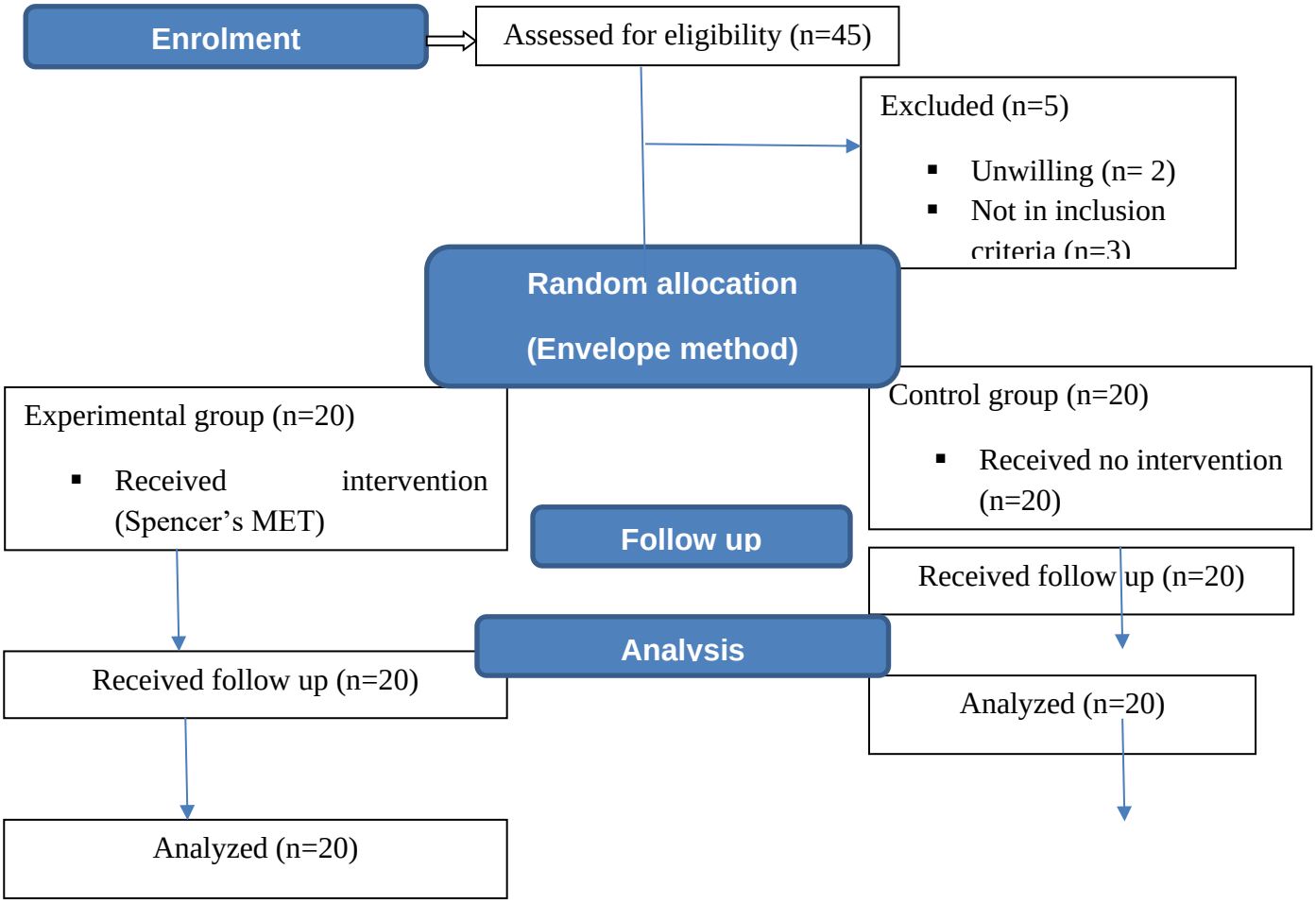


Table 4.1: Socio-demographic characteristics of participants

Socio-demographic variables	Experimental group		Control group	
	Frequency	Percentage	Frequency	Percentage
Age				
30-40 years	2	10	3	15
40-50 years	11	55	7	35
50-60 years	6	30	9	45
60-70 years	1	5	1	5
Mean age	49.75±8.52		49.10±9.01	
Gender				
Male	7	35	10	50
Female	13	65	10	50
Occupation				
House wife	10	50	8	40
Service holder	9	45	5	25
Business	1	5	4	20
Day labour			2	10
Other			1	5

Table no 4.1Demonstrate the demographic characteristics of both experimental and control group. In experimental group 11 respondents (55%) were of age group 40-50 years, 2 (10%), 6 (30%) and least 1 (5%) were on age group 30-40, 50-60 and 60-70 years whereas in control group 9 (45%) were in age group 50-60 years, 3 (15%), 7 (35%) and 1 (5%) were on age group 30-40, 40-50 and 60-70 years respectively. The mean value of age in the experimental group and control group were 49.75±8.52 and 49.10±9.01 respectively. In experimental group female respondents i.e. 13 (65%) were more than male respondents 7(35%) whereas in control group both male and female respondents were in same number i.e. 10 (50%) each. In experimental group, 10 (50%), 9 (45%) and 1 (5%) had occupation

as house wife, service holder and business whereas in control group 8 (40%), 5 (25%), 4 (20%), 2 (10%) and 1 (5%) had occupation as house wife, service holder, business, day labor and other respectively.

Figure 4.B.7 Mean age in both experimental and control group

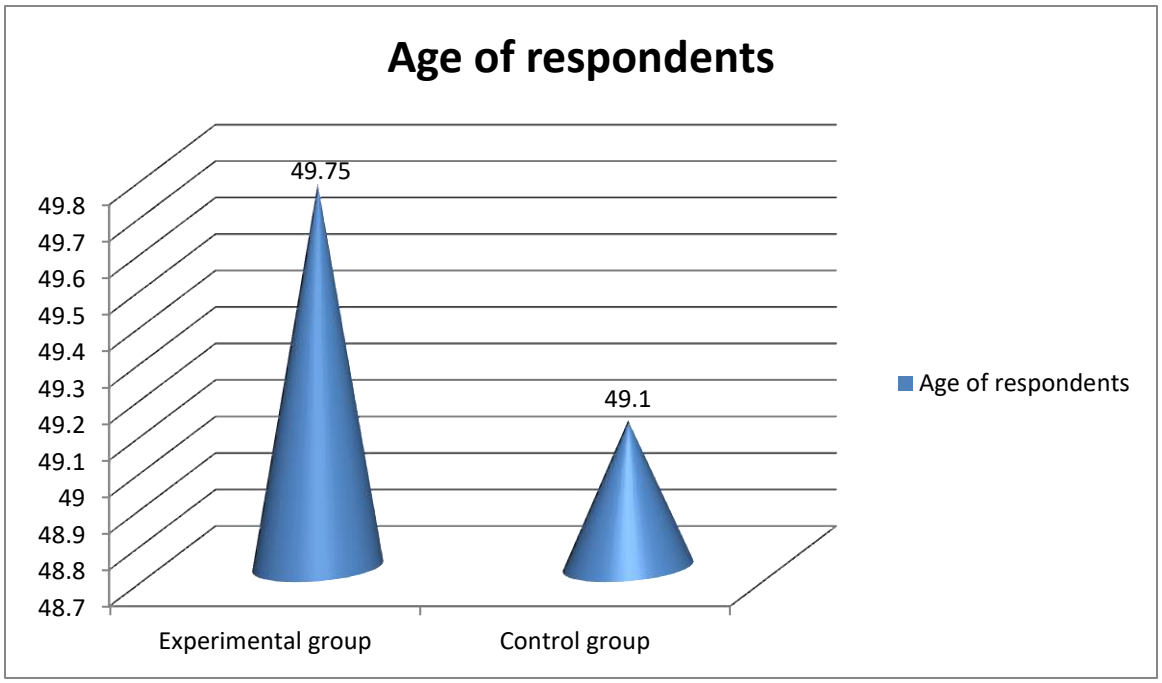


Figure 4.B.7 shows the mean of the subjects in the experimental group and control group were 49.75±8.52 and 49.10±9.01 respectively.

Table 4.2: Socio-demographic characteristics of respondents

Socio-demographic variables	Experimental group		Control group	
	Frequency	Percentage	Frequency	Percentage
Education Level				
Illiterate	4	20	2	10
Up-to class V	3	10	2	10
Up-to class VIII	1	5	3	15
SSC	4	20	5	25
HSC	2	10	3	15
Bachelor	4	20	2	10
Masters or above	2	10	3	15
Living Area				
Urban	5	25	8	40
Semi-urban	14	70	10	50
Rural	1	5	2	10
Diabetes				
Yes	8	40	10	50
No	12	60	10	50
Site				
Right	9	45	8	40
Left	11	55	11	55
Bilateral			1	5
Mean duration of problem	26.5±27.79 weeks		26.2±20.08 weeks	

Table no 4.1Demonstrate the demographic characteristics of both experimental group and control group. In experimental group 4 (20%) respondent were illiterate, 3 (15%), 1 (5%), 1 (5%), 4 (20%), 2 (10%), 4 (20%) and 2 (10%) had education up-to class V, up-to class VIII, SSC, HSC, Bachelor and Masters or above whereas in control group 2 (10%) were illiterate, 2 (10%), 3 (15%), 2 (10%), 3 (15%), 3 (15%), 2 (10%), and 3 (15%), had

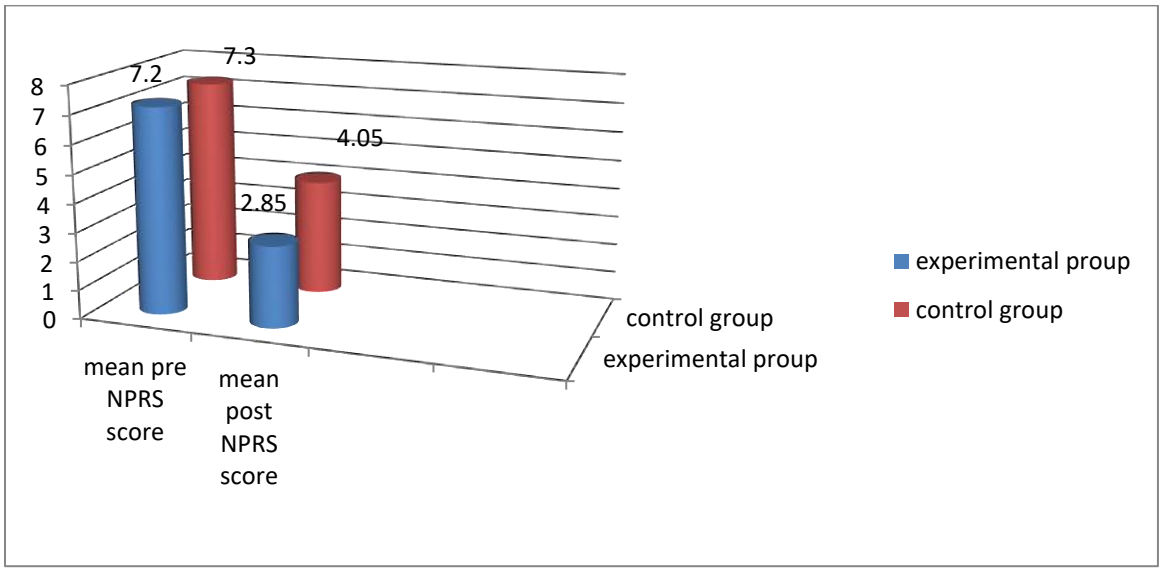
education up-to class V, up-to class VIII, SSC, HSC, Bachelor and Masters or above respectively. In experimental group 14 (70%) respondents lives in semi-urban area, 5 (25%) on urban area and 1 (5%) only on rural area whereas in control group 8 (40%), 10 (50%) and 2 (10%) lives in urban, semi-urban and rural area respectively. In experimental group 8 (40%) were diabetic and under medication whereas in control group 10 (50%) were diabetic and under medication. In experimental group 9 (45%) had problem on right shoulder and 11 (55%) on left shoulder whereas in control group 8 (40%) had on right shoulder, 11 (55%) on left shoulder and 1 (5%) had problem on both site. The mean duration of problem in experimental group is 26.5±27.79 whereas in control group is 26.2±20.08.

Table 4.3: mean difference between pre and post NPRS score in experimental and control group (paired sample t-test and Wilcoxon Sign Rank Test)

Groups	Pre intervention		Post intervention		t and w value	p value
	Mean	SD	Mean	SD		
Experimental	7.2	1.05	2.85	0.87	t=26.1	0.000
Control	7.3	1.13	4.05	0.86	W=-4.06	0.000

The mean value of NPRS score in two different periods (pre intervention and post intervention) in both experimental and control group are described in this table. In experimental group the mean NPRS score in all two periods were 7.2±1.05 and 2.85±0.87 whereas in control group 7.3±1.13 and 4.05±0.86 respectively. In experimental group, Paired sample t test is used to find the significance of treatment on pain intensity. The values are t=26.1, p value 0.000 for NPRS score which indicate that the Spencer's MET is highly significant and we accept alternate hypothesis that there is significant difference in reducing shoulder pain intensity on overhead movement after application of Spencer's MET in frozen shoulder patients. In control group, Wilcoxon Sign Rank Test is used to find the significance of treatment on pain intensity. The values are W=-4.06, p value 0.000 for NPRS score which indicate that conventional treatment is highly significant and we accept alternate hypothesis that there is significant difference in reducing shoulder pain intensity on overhead movement after application of conventional treatment in frozen shoulder patients.

Figure 4.B.8: Mean of NPRS score for both experimental and control group among two periods (pre intervention and post intervention) N=20



The above diagram shows there is decrement seen in post NPRS score in both experimental and control group.

Table 4.4: Mean change in NPRS score for both the groups after intervention (Independent sample t test)

Groups	**Mean of post intervention score**	**± SD**	**U value**	**P value**
Experimental	2.85	0.87	82	0.001
Control	4.05	0.86		

The mean of post intervention NPRS score in experimental and control group is 2.85±0.87 and 4.05±0.86 respectively. P value of Mann Whitney U test is 0.001 and U=82 which indicate there is significant different in improvement between groups and we accept alternate hypothesis. Experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment in terms of pain intensity in NPRS scale.

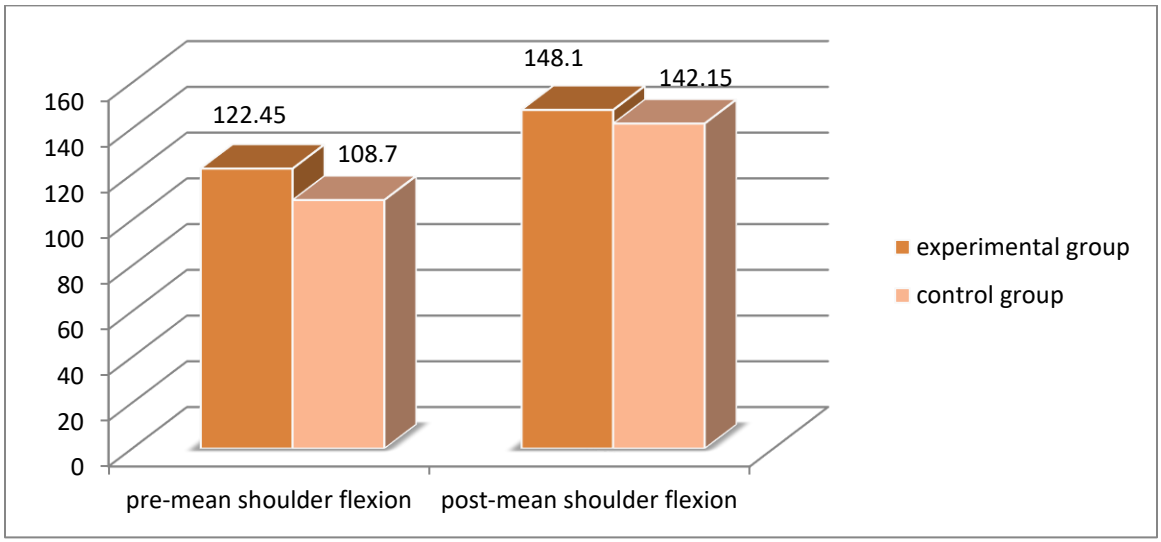
Table4.5: Mean between Pre and Post shoulder Flexion, Abduction, Internal Rotation and External Rotation ROM in experimental group and control group (paired sample t test)

Variables	Period	Experimental group		Control group	
		Mean	**SD**	**Mean**	**SD**
Shoulder flexion	Pre intervention	122.45	21.40	108.7	17.82
	Post intervention	148.1	18.36	142.15	16.91
	Paired sample t-test	t(-14.8), p-value 0.000		t(-15.6), p-value 0.000	
Shoulder abduction	Pre intervention	96	15.41	95.25	13.53
	Post intervention	119.75	15.65	129.05	13.27
	Paired sample t test	t(-14.34), p-value 0.000		t(-23.5), p-value 0.000	
Shoulder internal rotation	Pre intervention	40	13.45	32.65	7.99
	Post intervention	56.1	13.36	54	9.47
	Paired sample t test	t(-16.28), p-value 0.000		t(-20.85), p-value 0.000	
Shoulder external rotation	Pre intervention	25.95	11.03	20.9	9.02
	Post intervention	44.85	13.15	40.65	9.75
	Paired sample t test	t(-14.85), p-value 0.000		t(-17.69), p-value 0.000	

The mean value of shoulder flexion, abduction, internal rotation and external rotation in all the two periods (pre and post) of experimental group and control group are described in the given table. In experimental group the mean of shoulder flexion in pre and post intervention were 122.45±21.4 and 148.1±18.36 whereas in control group 108.7±17.82 and 142.15±16.91 respectively. In experimental group mean of shoulder abduction in all the two periods were 96±15.41 and 119.75±15.65 whereas in control group 95.25±13.53 and 129.05±13.27 respectively. In experimental group mean of shoulder internal rotation in the two periods were 40±13.45 and 56.1±13.36 whereas in control group 32.65±7.99 and 54±9.47 respectively. In experimental group mean of shoulder external rotation in the two

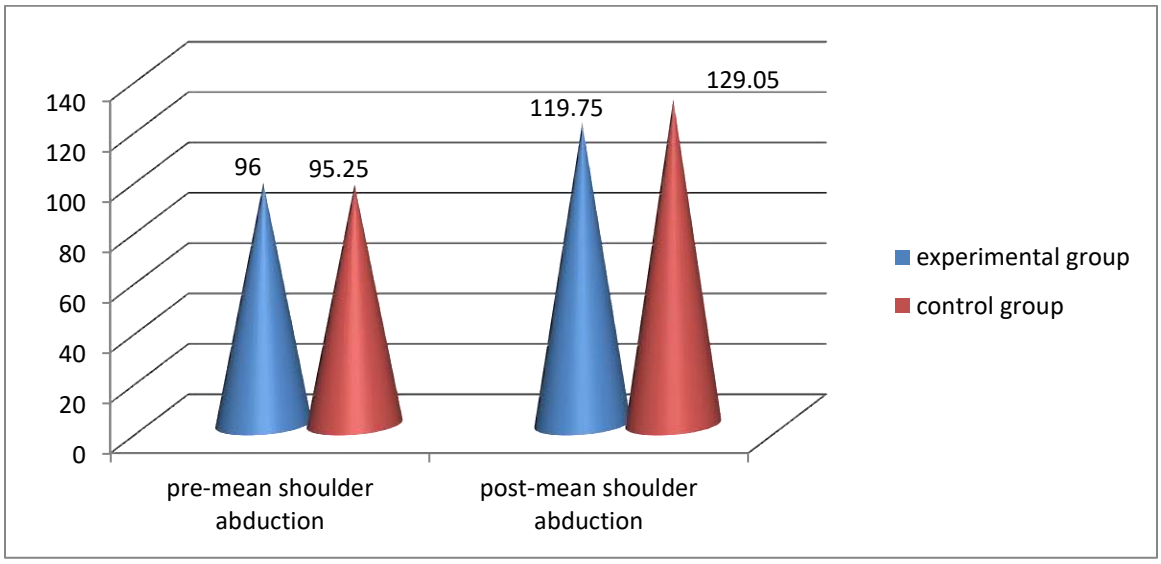
periods were 25.91±11.03 and 44.85±13.15 whereas in control group 20.9±9.02 and 40.65±9.75 respectively. Paired sample t test is used to find the significance of treatment within experimental group and control group. In experimental group, the values are t(-14.8), p-value 0.000 for shoulder flexion, t(-14.34), p-value 0.000 for shoulder abduction, t(-16.28), p-value 0.000 for shoulder internal rotation and t(-14.85), p-value 0.000 for shoulder external rotation which indicate that the Spencer's MET is highly significant and we accept the alternate hypothesis that there is significant difference in improving shoulder flexion, abduction, internal rotation and external rotation ROM after application of Spencer's MET in frozen shoulder patients. In control group, the values are t(-15.6) p-value 0.000 for shoulder flexion, t(-23.5) p-value 0.000 for shoulder abduction, t(-20.85) p-value 0.000 for shoulder internal rotation and t(-16.79) p-value 0.000 for shoulder external rotation which indicate that the conventional treatment is highly significant and we accept the alternate hypothesis that there is significant difference in improving shoulder flexion, abduction, internal rotation and external rotation ROM after application of conventional treatment in frozen shoulder patients.

Figure 4.B.9: Mean of shoulder flexion for both experimental and control group among the two periods (pre intervention and post intervention (after 4 sessions)) N=20



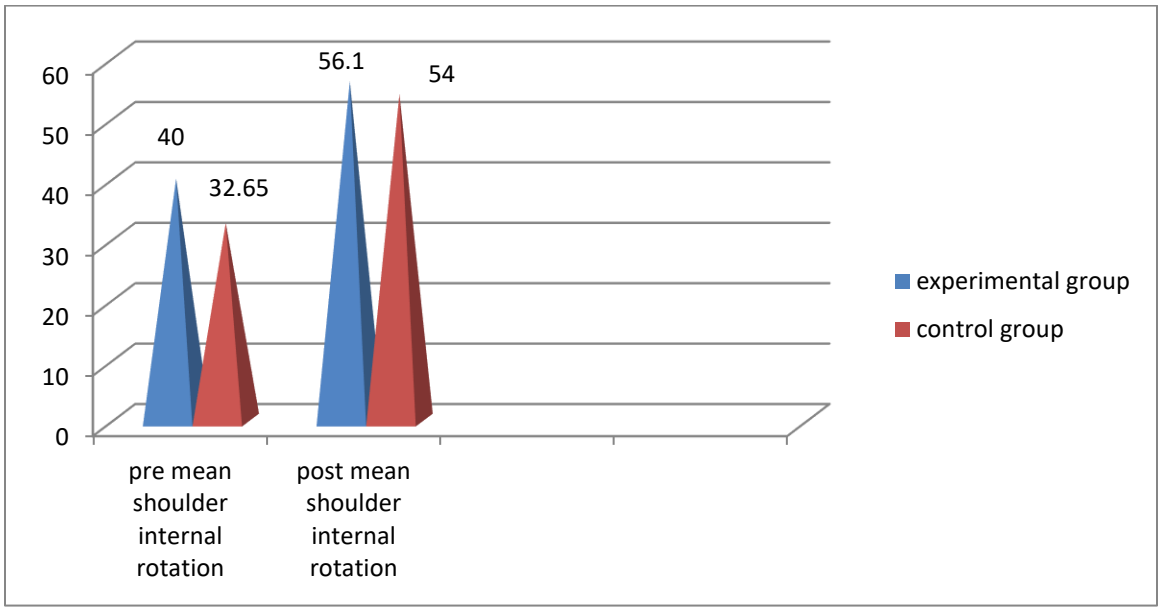
The above diagram shows there was increment seen in post mean shoulder flexion ROM in both experimental group and control group.

Figure 4.B.10: mean of shoulder abduction for both experimental and control group among the two periods (pre intervention and post intervention (after 4 sessions))



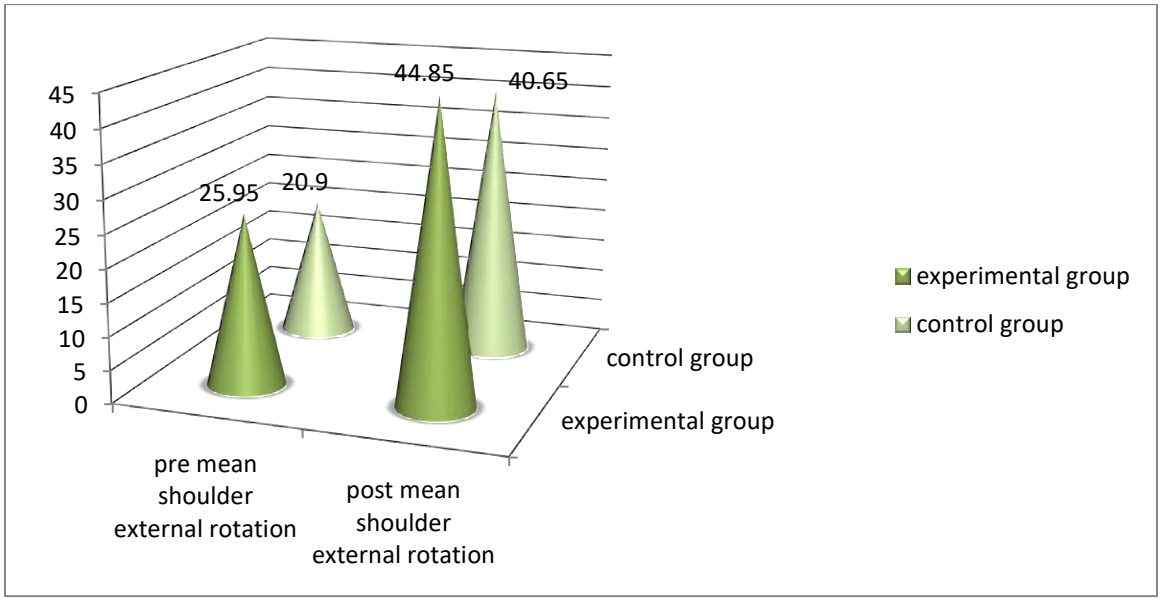
The above diagram shows there was increment seen in post mean shoulder abduction ROM in both experimental group and control group

Figure 4.B.11: Mean of shoulder internal rotation ROM for both experimental and control group among the two periods (pre intervention and post intervention (after 4 sessions)) N=20



The above diagram shows there was increment seen in post mean shoulder internal rotation ROM in both experimental and control group

Figure 4.B.12: Mean of shoulder external rotation for both experimental and control group among the two periods (pre intervention and post intervention (after 4 sessions)) N=20



The above diagram shows there was increment seen in post mean shoulder external rotation ROM in both experimental group and control group**.**

Table4.6: Mean change in shoulder flexion ROM score for the both group pre and post intervention (Independent sample t test)

Groups	Mean change in score	SD	t value	p value
Experimental group	25.65	7.75	-2.829	0.007
Control group	33.45	9.58		

The mean changed score for shoulder flexion was 25.65±7.75 for experimental group and 33.45±9.58 for control group. The p value of independent sample t test is 0.007 and t=-2.829 which indicate there is significant difference in improvement between and we accept alternate hypothesis. Control group receiving conventional treatment improve much better than experimental group receiving Spencer's MET in term of shoulder flexion ROM.

Table4.7: Mean change in shoulder abduction ROM score for both groups pre and post intervention (independent sample t test)

Groups	Mean change in score	SD	t value	p value
Experimental group	23.75	7.40	-4.58	0.000
Control group	33.80	6.44		

The mean changed score for shoulder abduction was 23.75±7.40 for experimental group and 33.80±6.44 for control group. An independent sample t test value p is 0.000 and t=-4.58 which indicate there is significant different in improvement between groups and we accept alternate hypothesis. Control group receiving conventional treatment improved much better than experimental group receiving Spencer's MET in terms of shoulder abduction ROM.

Table 4.8: Mean change in shoulder internal rotation ROM score for both groups pre and post intervention (independent sample t test)

Groups	Mean change in score	SD	t value	p value
Experimental group	16.1	4.42	-3.68	0.001
Control group	21.35	4.56		

The mean changed score for shoulder internal rotation was 16.1±4.42 for experimental group and 21.35±4.56 for control group. An independent sample t test value p is o.001 and t=-3.68 which indicate there was significance difference in improvement between groups and we accept alternate hypothesis. Control group receiving conventional treatment improved much better than experimental group receiving Spencer's MET in terms of shoulder internal rotation ROM.

Table 4.9: Mean change in shoulder external rotation ROM score for both groups pre and post intervention (Independent sample t test)

Groups	Mean change in score	SD	t value	p value
Experimental group	18.9	5.69	-0.502	0.619
Control group	19.75	4.99		

The mean changed score for shoulder external rotation was 18.9±5.69 for experimental group and 19.75±4.99 for control group. An independent sample t test value p is 0.619 and t=-0.502 which indicate there is significant difference in improvement between groups and we accept null hypothesis. Both groups improve equally in terms of shoulder external ROM.

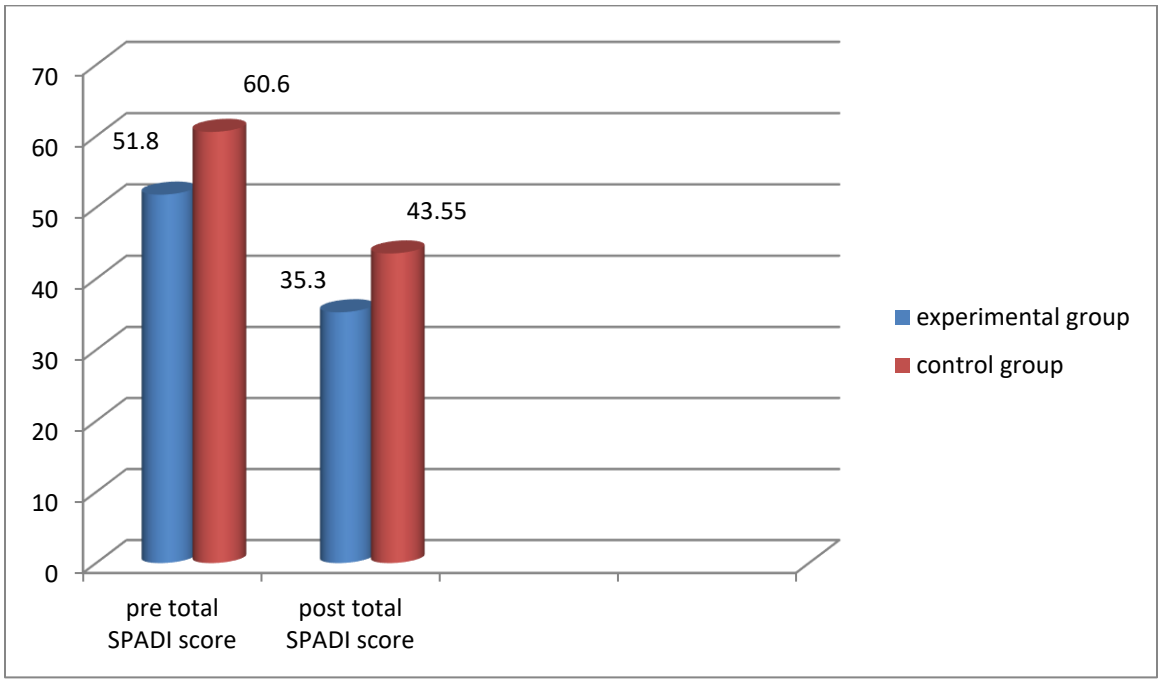
Table 4.10: Mean difference between Pre and Post SPADI score in experimental group and control group (paired sample t-test)

Groups	Pre intervention		Post intervention		t value	p value
	Mean	SD	Mean	SD		
Experimental group	51.8	8.03	35.3	5.93	17.31	0.000
Control group	60.60	9.29	43.55	11.19	18.55	0.000

The mean value of SPADI score in all the two periods (pre and post) of experimental group and control group are described in the given table.

In experimental group, mean of SPADI in the two periods were 51.80±8.03 and 35.30±5.93 whereas in control group were 60.60±9.29and 43.55±11.19 respectively. Paired sample t test is used to find the significance of treatment within experimental group and control group. In experimental group, the values are t (17.31) p-value 0.000 for SPADI score which indicate that the Spencer's MET is highly significant and we accept the alternate hypothesis that there is significant difference in reducing shoulder pain and disability score after application of Spencer's MET on frozen shoulder patients. In control group, the values are t (18.55) p-value 0.000 for SPADI score which indicate that the conventional treatment is highly significant and we accept the alternate hypothesis that there is significant different in reducing shoulder pain and disability score after application of conventional treatment in frozen shoulder patients.

Figure 4.B.13: Mean of total SPADI score for both experimental and control group among the two periods (pre intervention and post intervention(after 4 sessions))N=40



The above diagram shows there was decrement seen in post total SPADI score in both experimental and control group.

Table 4.11: Mean of post treatment total SPADI score for both the groups after intervention (Independent sample t test)

Groups	Post treatment scores Mean	SD	t value	p value
Experimental group	35.3	5.9	-2.913	0.006
Control group	43.55	11.2		

The mean of post treatment total SPADI score was 35.3±5.9 for experimental group and 43.55±11.2 for control group. An independent sample t test value p is 0.006 and t=-2.913 which indicate there is significant difference in improvement in total SPADI score between groups and we accept alternate hypothesis. Experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment in terms of SPADI score.

CHAPTER V
DISCUSSION

Frozen shoulder is considered as a serious complication as it restricts the overhead shoulder movement and adversely affect in ADLS. Over a period of 6 months, a total 45 individuals with frozen shoulder were screened for the study, inclusive of inmates of frozen shoulder with or without diabetes mellitus. However, 5 were excluded based on exclusion criteria. 40 subjects fulfilling inclusion criteria and willing to participate in the study were enrolled for the study. The subjects were randomly allocated into two different groups (experimental and control) with equal number each (n=20) based on convenience of researcher. Experimental group received IRR and Spencer's MET whereas control group received conventional treatment protocol. No subjects dropped out of the study after enrolment. Shoulder pain, ROM and shoulder disability from all 40 subjects was collected pre and post intervention after completing 4 sessions. Spencer's MET was performed in a sequence of MET on shoulder extension, flexion, circumduction compression, circumduction traction, abduction with external rotation, abduction with internal rotation, internal rotation and traction of deltoid. The present study was conducted to find out the short-term effect of Spencer's MET on pain, ROM and disability on frozen shoulder patients and compare it with conventional treatment protocol of CRP. In this study both treatment group shows significant improvement in terms of pain, ROM, and shoulder disability in 4 sessions of treatment. Both treatment groups show statistically significant results on pain intensity, ROM and SPADI on frozen shoulder patients.

Present study showed the mean age of subjects in experimental group as 49.75±8.52 with 35% male and 65% female and in the control group as 49.10±9.01 with 50% male and 50% female respectively. The mean age was 50.80±6.48 years in experimental group and 51.13±5.77 years in control group in a study conducted by Narayan (2014) studied muscle energy technique in frozen shoulder patients to find its efficacy on functional ability of shoulder.

To find the significance of treatment within group analysis paired sample t test was used with $p<0.05$ considered as significant result. The independent sample t test was used to find the significant difference in treatment between experimental group and control group with $p<0.05$ considered as significant difference in treatment. Regarding the NPRS

score in experimental group, results demonstrated that there was a statistically significant reduction in pain intensity with pre and post NPRS value 7.2±1.05 and 2.85±0.87 respectively and p value 0.000, t=26.1 on paired sample t test. In control group, there was statistically significant reduction in pain intensity with pre and post NPRS value 7.3±1.13 and 4.05±0.86 respectively and p value 0.000, W=-4.06 on Wilcoxon Sign Rank Test.

The reason behind the reduction of pain in experimental group could be neurological and tissue factor due to Spencer's MET and superficial heating effect of IRR. During Spencer's MET, there is stimulation of low threshold mechanoreceptors within joints and muscles. It lead to generation of symapatho-excitation stimulus from somatic efferent which helps in localize activation on preiaqueductal grey matter in mid brain. Nociceptive inhivitors from mid brain then block the nociceptive impulses in dorsal horn of spinal cord by closing the gait. Through this pain gait pathway, pain is modulated or suppressed through activation of mechanoreceptor within joints and muscles (Leon Chaitow, 2013). The reason behind the reduction of pain in control group could be superficial heating effect of IRR which help in vascular dilatation and alteration on pain threshold through heating effect on localized tissue. This vascular dilation helps in nutrient and oxygen supply, removes metabolites and waste product and enhances process of inflammation (May S. F. Leung, and Gladys L. Y. Cheing, 2008) exercise within pain free ROM helps in synovial fluid movement within joints, stimulates mechanoreceptors which intern helps in reflex relaxation of muscles and reduce pain and inflammation (Leon Chaitow, 2013). Capsular stretching on the other hand has positive impact on pain intensity and ROM as described by a comparative study on effectiveness of capsular stretching along with conventional treatment versus muscle energy technique in the management of frozen shoulder patients.

Present studies support the findings of previous study which has found significant reduction in pain intensity.

Regarding the shoulder ROM in experimental group, results demonstrated that there was statistically significant improvement in shoulder flexion, abduction, internal rotation and external rotation ROM with p value 0.000, t=-14.8 for shoulder flexion, p value 0.000, t=-14.34 for shoulder abduction, p value 0.000, t=-16.28 for shoulder internal rotation and p value 0.000, t=-14.84 for shoulder external rotation respectively. In control

group, the result demonstrated that there was statistically significant improvement in shoulder flexion, abduction, internal rotation and external rotation ROM with p value 0.000, t=-15.6 for shoulder flexion, p value 0.000, t=- 23.5 for shoulder abduction, p value 0.000, t=-20.85 for shoulder internal rotation and p value 0.000, t=-16.79 for shoulder external rotation respectively on paired sample t test.

The possible mechanism for improving shoulder ROM could be reflex muscle relaxation and tissue texture change during Spencer's MET. Golgi tendon organ plays a major role in reflex relaxation following isometric contraction. Muscles contraction against equal resistance in Spencer's MET stimulate Golgi tendon organ. The afferent nerve impulse from golgi tendon organ reach dorsal root of spinal cord where it interact with inhibitory efferent motor neuron. They inhibit the release of efferent motor neuron impulse and prevent the further muscle contraction. The muscle tone decreases which further stimulate agonist relaxation and lengthening of muscles. This all leads to increase in ROM through muscle relaxation following isometric contraction in a reflex pattern (Gupta et al., 2012)

Independent sample t test was used to compare the statistically significant improvement in shoulder ROM between groups. The result demonstrated that there was statistically significant improvement in shoulder flexion, abduction and internal rotation ROM with p value 0.007, t=-2.829 for shoulder flexion, p value 0.000, t=-4.58 for shoulder abduction and p value 0.001, t=-3.68 for shoulder internal rotation respectively which indicate that control group receiving conventional treatment improved much better than experimental group receiving Spencer's MET. The possible reason could be Maitland mobilization and capsular stretching which was applied directly on shoulder joint and have great impact on shoulder ROM. Whereas there was not statistically significant improvement in shoulder external rotation ROM with p value 0.619 and t=-0.505 indicating there was no significant difference in shoulder external rotation ROM in group receiving Spencer's MET and conventional treatment.

Present studies support the findings of previous study which has found significant improvement in shoulder flexion, abduction, internal rotation and external rotation ROM.

Regarding the SPADI score in experimental group, result demonstrated that there was a statistically significant reduction in shoulder pain and disability index with pre and

post SPADI value 51.80±8.03 and 35.30±5.93 respectively with p value 0.000, t=17.31 on paired sample t test. In control group, the result demonstrated that there was a statistically significant reduction on shoulder pain and disability index with pre and post SPADI value 60.60±9.29and 43.55±11.19 respectively with p value 0.000, t=18.55 on paired sample t test. This result indicates that both treatment techniques (Spencer's MET and conventional treatment) are effective in reducing SPADI score within group analysis.

On Independent sample t test the result demonstrated that there was a significant difference in improvement in total SPADI score with p value 0.006 and t=-2.913 indicating experimental group receiving Spencer's MET improved much better than control group receiving conventional treatment in terms of SPADI score. The possible reason could be significant reduction of pain intensity on experimental group.

Our study was supported by a study done by to find the comparative effect of Spencer's MET versus mulligan mobilization with movement (MMW) technique for frozen shoulder patients. They found that both Spencer's MET and mulligan techniques have statistically significant improvement in pain, shoulder ROM and functional disability within group analysis. Between group analysis they found that there was not statistically significant difference in pain intensity between groups but there was statistically significant improvement in shoulder mobility and functional disability in which the group receiving mulligan mobilization improved much better than group receiving Spencer's MET in terms of shoulder ROM and functional disability.

Our study was supported by a study done by Narayan to find the effects of muscle energy technique in adhesive capsulitis patients in terms of functional ability. They found that both MET group and conventional treatment group showed significant difference and improvement on SPADI score after treatment. They further concluded that experimental group receiving MET had better improvement in magnitude (%) than control group receiving conventional treatment.

Another study done by Arul kumar to find the effectiveness of MET with mobilization against mobilization alone in frozen shoulder patients supports our study. They found that both MET with mobilization and mobilization alone had significant improvement on reducing shoulder pain, SPADI index and shoulder ROM. They further concluded that there is not significant difference in reduction of pain and SPADI index in

between group analysis whereas group receiving MET and mobilization improved much better than mobilization alone in terms of shoulder flexion, abduction, internal rotation, extension and external rotation ROM and their difference in improvement is statistically significant.

Study done by to find the effectiveness of Spencer's MET on pain and functional disability among frozen shoulder patients supports our study. They found that both Spencer's MET and conventional treatment show statistically significance difference in reducing shoulder pain and SPADI index within group analysis. They further concluded that there is no significant difference in reducing shoulder pain intensity between groups receiving Spencer's MET and conventional treatment whereas group receiving Spencer's MET improved much better and there is statistically significant improvement in terms of SPADI score than group receiving conventional treatment in between group analysis.

CHAPTER VI

CONCLUSION

In this study, it was found that the Spencer's MET was effective in reducing shoulder pain, improving shoulder ROM and reducing shoulder disability. Both Spencer's MET and conventional treatment protocol has significant results on reducing pain, improving ROM and reducing shoulder disability but when comparing its actual effect Spencer's MET was more effective on reducing shoulder pain whereas conventional treatment was more effective on improving shoulder ROM. We can conclude Spencer's MET can be used or incorporate as alternate treatment approach or combine with other treatment technique to reduce pain, improve ROM and reducing shoulder disability in frozen shoulder patients.

LIMITATION OF THIS RESEARCH

Several limitations of this study should be considered. First, the sample size for this study is small in both experimental group and control group which was not enough for the study to generalize the result in whole population. The study duration was also short and only 4 sessions of treatment was provided to both experimental group and control group. There was no long term follow up to measure the actual effect so long-term effect of Spencer's MET was not explored or explained in this study. The daily activities of the participants were not monitored which could have influenced the research. There were few researches done in Bangladesh regarding frozen shoulder and very limited research on Spencer's MET which result on limited relevant information regarding this technique and information regarding frozen shoulder in Bangladesh. Due to unavailability of frozen shoulder patients in CRP, we have to compromise on sampling methods and blinding procedure.

FUTURE RECOMMENDATION

After this research researcher is recommended to do further research on Spencer's MET with large number of participants with long time frame. It is recommended to follow strict randomization and standardized blinding process to improve quality of research. Follow up data is recommended to find the actual effect of Spencer's MET on long term.

It is better to monitor activities of daily living within intervention periods which have potential to influence the results. It is recommended to conduct experimental research on effects of Spencer's MET with or without conventional treatment and other manual therapy procedures to find the actual effectiveness.

CHAPTER VII

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CHAPTERVIII

APPENDIXES

APPENDIX I. INFORMED CONSENT FORM (English and Bengali)

TITLE OF RESEARCH: "EFFECTS OF SPENCERS MUSCLE ENERGY TECHNIQUE ON FROZEN SHOULDER PATIENTS ATTENDING AT CRP"

INVESTIGATOR: ANIL RIMAL

INTRODUCTION:

This research is an experimental study to measure the effect of Spencer's muscle energy technique on pain, ROM and disability in frozen shoulder patients and compare it with conventional treatment in CRP. Patients of aged 35-70 years with frozen shoulder with or without diabetes will be included for the study as per the inclusion criteria.

EXPLANATION OF PROCEDURE:

In this study, the subjects who meet the inclusion criteria will be divided into Spencer's muscle energy group and conventional treatment group. The ROM of shoulder, shoulder pain and disability index on patients before application of interventions will be measured. One group will receive Spencer's muscle energy technique and conventional treatment whereas other group received conventional treatment on CRP for four sessions. Each session will take 30 minutes. The ROM, pain score and disability index will be measured after 4 sessions.

POSSIBLE BENEFITS:

The investigators do not promise or guarantee that you will receive direct benefit from being in the study. There also may be benefits involved that are not known to the researcher at this time.

POSSIBLE RISKS:

There are no known physical risks for the persons associated with these methods.

CONFIDENTIALITY:

The result of the study may be published for scientific purpose, however your identification will not be revealed.

WITHDRAWL:

Participation in the study is voluntary; if you do not wish to participate in the study you will not lose benefits to which you are entitled. You are free to withdraw your consent and discontinue your participation in this project at any time.

PAYMENT FOR PARTICIPATION:

There will be no payment to you for participating in the study.

LEGAL RIGHTS:

By signing this consent form you are not waiving any of your legal rights.

CONSENT STATEMENT:

My signature below indicates that I have decided to participate in the study and that I have read (or been read) the information provided above and that I was given the opportunity to answer the questions.

Signature of the participant	Signature of investigator
Date:	Date:

APPINDIX III. SOCIO-DEMOGRAPHIC QUESTIONNAIRE (ENGLISH AND BENGALI)

Id no:

1. **Name:**
2. **Age:**
3. **Gender:**☐Male ☐Female☐ Other
4. **Marital status:** ☐ Married ☐Unmarried ☐Divorced ☐ Widowed ☐ Separated
5. **Education:**☐ Illiterate ☐upto Class V ☐Upto Class VIII ☐Upto Class X ☐ SSC ☐ HSC ☐ Bachelor ☐ Masters or Above
6. **Occupation:** ☐ House Wife ☐ Service Holder ☐ Business ☐ Day Laborer ☐ Farmer ☐ Other ☐ N/A
7. **Religion:**
8. **Living area:**☐ Urban ☐ Semi-Urban ☐ Rural
9. **Monthly Family Income:**
10. **Duration:**
11. **Site:** ☐ Rt ☐ Lt ☐ B/L
12. **Diabetes:** ☐ Yes ☐ No
13. **Surgical history:** ☐ Yes ☐ No if Yes, specify

APPINDIX III. PROFORMA (ENGLISH AND BENGALI)

S.N	OUTCOME MEASURES	PRE-TEST	POST-TEST
1	**Numerical Pain Rating Scale (NPRS)**		
	On shoulder movement		
2	**Range of motion(ROM)**		
	Shoulder flexion		
	Shoulder abduction		
	Shoulder internal rotation		
	Shoulder external rotation		
3	**SPADI score**		
	Total pain score		
	Total disability score		
	Total SPADI Score		

APPINDIX IV. SHOULDER PAIN AND DISABILITY INDEX (ENGLISH AND BENGALI)

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

PAIN SCALE

How severe is your pain?

Circle the number that best describes your pain where: 0 = no pain and 10 = the worst pain imaginable.

At its worst?	0	1	2	3	4	5	6	7	8	9	10
When lying on the involved side?	0	1	2	3	4	5	6	7	8	9	10
Reaching for something on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Touching the back of your neck?	0	1	2	3	4	5	6	7	8	9	10
Pushing with the involved arm?	0	1	2	3	4	5	6	7	8	9	10

DISABILITY SCALE

How much difficulty do you have?

Circle the number that best describes your experience where: 0 = no difficulty and 10 = so difficult it requires help.

Washing your hair?	0	1	2	3	4	5	6	7	8	9	10
Washing your back?	0	1	2	3	4	5	6	7	8	9	10
Putting on an undershirt or jumper?	0	1	2	3	4	5	6	7	8	9	10
Putting on a shirt that buttons down the front?	0	1	2	3	4	5	6	7	8	9	10
Putting on your pants?	0	1	2	3	4	5	6	7	8	9	10
Placing an object on a high shelf?	0	1	2	3	4	5	6	7	8	9	10
Carrying a heavy object of 10 pounds (4.5 KG)	0	1	2	3	4	5	6	7	8	9	10
Removing something from your back pocket?	0	1	2	3	4	5	6	7	8	9	10

INTERPRETATION OF SCORES

Total pain score: / 50 x 100 = %

Total disability score: / 80 x 100 = %

Total SPADI score: / 130 x 100 = %

The means of the two subscales are averaged to produce a total score ranging from 0 (best) to 100 (worst).

Minimum Detectable Change (90% confidence) = 13 points (Change less than this may be attributable to measurement error).

Bangla Version of Shoulder Pain Assessment and Disability Index (B-SPADI)

(অনুগ্রহ করে প্রশ্নগুলো মনোযোগ দিয়ে পড়ুন এবং যে নম্বরটি আপনার অবস্থাকে সবচেয়ে ভালোভাবে বিশ্লেষন করে তাতে গোল দাগ দিন)

রোগীর নাম: **তারিখ:**

ব্যথার পরিমাপক

কোন ব্যথাই নাই	০	১	২	৩	৪	৫	৬	৭	৮	৯	১০	অকল্পনীয় ব্যথা

আপনার ব্যথা কতটা তীব্র ?

১) এটা কি চরম ব্যথা ?

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

২) ব্যথার দিকে শোয়ার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৩) উঁচু তাক পর্যন্ত হাত নিতে

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৪) ঘাড়ের পিছনে হাত নিতে

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৫) যে হাতে ব্যথা সে হাত দিয়ে কিছু ধাক্কা দিতে

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

অক্ষমতার পরিমাপক

কোন কষ্টই হয় না	০	১	২	৩	৪	৫	৬	৭	৮	৯	১০	এতই কষ্ট হয় যে অন্যের সাহায্য নিতে হয়

আপনার কতটা সমস্যা হয় ?

১) চুল ধোয়ার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

২) পিঠ পরিষ্কার করার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৩) গেন্জি/সেমিজ বা শীতের কাপড় পরার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৪) জামা পরে সামনের বোতাম লাগানোর সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৫) প্যান্ট/পাজামা পরার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৬) উচুঁ তাকে কিছু রাখার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৭) ১০ পাউন্ড (৪.৫ কেজি) ওজনের কিছু বহন করার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

৮) পিছনের পকেটে হাত দেওয়ার সময়

০	১	২	৩	৪	৫	৬	৭	৮	৯	১০

APPINDIX V. APPROVAL OF THESIS PROPOSAL

Date: 20-Aug -2019

To,
The Chairman
Institutional Review Board (IRB)
Bangladesh Health Professions Institute (BHPI)
CRP-Savar, Dhaka-1343, Bangladesh
Subject: Application for review and ethical approval

Sir,

With due respect I would like to draw your kind attention that I am a student of M.Sc. in Rehabilitation Science program at Bangladesh Health Professions Institute (BHPI)- an academic institute of CRP under Faculty of Medicine, University of Dhaka (DU). This is a 2-year full-time course under the project of "Regional Inter-Professional Masters program in Rehabilitation Science" funded by SAARC Development Fund (SDF). I have to conduct a thesis entitled, **"IMMEDIATE EFFECT OF SPENCERS MUSCLE ENERGY TECHNIQUE VS MUSCLE RELEASE TECHNIQUE ON PAIN AND RANGE OF MOTION OF FROZEN SHOULDER PATIENTS ATTENDING ON CRP, SAVAR"** under the honorable supervisor, **Firoz Ahmed Mamin, Associate professor, Department of Rehabilitation science, BHPI, Dhaka, Bangladesh**. The purpose of the study is to measure the immediate effect of Spencers muscle energy technique on pain and ROM in frozen shoulder patients and compare it with Muscle release technique in CRP.

The study involves measuring the ROM of shoulder and pain scale on patients before application of interventions. One group will receive Spencers muscle energy technique and other group receive Muscle release technique on CRP. The intervention will take 30 minutes. The pain scale and ROM will be measured after treatment. There is no likelihood of any harm to the participants and /or participation in the study may benefit the participants or other stakeholders. Related information will be collected from the patient's guide books. Data collectors will receive informed consent from all participants. Any data collected will be kept confidential.

Therefore, I look forward to having your kind approval for the thesis proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

Anil Rimal
Part-II MRS 5th Batch
Student of M.Sc. in Rehabilitation Science (MRS)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Recommendation from the thesis supervisor:
Firoz Ahmed Mamin,
Associate professor, Department of Rehabilitation science, BHPI, Dhaka, Bangladesh

Forwarded
Fry
20.08.19

Firoz Ahmed Mamin
Associate Professor
Dept. of Rehabilitation Science
Coordinator
M.Sc. in Physiotherapy Program
BHPI, CRP, Savar, Dhaka-1343

APPINDIX VI. PERMISSION LETTER FOR DATA COLLECTION

Date: 20/08/2019

To,

The Head of the Department of physiotherapy

CRP, Bangladesh

Subject: Application for permission to collect data in Musculoskeletal Unit at CRP

Dear Sir,

After per my thesis study, titled, "**IMMEDIATE EFFECT OF SPENCERS MUSCLE ENERGY TECHNIQUE VS MUSCLE RELEASE TECHNIQUE ON PAIN AND RANGE OF MOTION OF FROZEN SHOULDER PATIENTS ATTENDING ON CRP, SAVAR**", under the honorable supervisor, Firoz Ahmed Mamin, Associate professor Department of Rehabilitation science, BHPI, Dhaka, Bangladesh. The purpose of the study is to measure the immediate effect of Spencers muscle energy technique on pain and ROM in frozen shoulder patients and compare it with Muscle release technique in CRP.

The study involves measuring the ROM of shoulder and pain scale on patients before application of interventions. One group will receive Spencers muscle energy technique and other group receive Muscle release technique on CRP. The intervention will take 30 minutes. The pain scale and ROM will be measured after treatment. There is no likelihood of any harm to the participants and / or participation in the study may benefit the participants or other stakeholders as service quality gap can be determined to identify patient satisfaction on services delivered and accordingly necessary measures can be taken to provide quality care to the Spinal cord injury patients. Related information will be collected from the patient's guide books. Data collectors will receive informed consent from all participants. Any data collected will be kept confidential.

Sincerely,

Anil Rimal

MRS 5th Batch

BHPI, Bangladesh

Recommended
20.8.19
Muhammad Millat Hossain
Assistant Professor
Project & Course Coordinator
Dept. of Rehabilitation Science
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Supervisor

Firoz Ahmed Mamin

Associate Professor, Department of Rehabilitation science, BHPI, Dhaka, Bangladesh

Forwarded
Fry
20.08.19
Firoz Ahmed Mamin
Associate Professor

Rumana
FARJANA SHARMIN
CRP, Savar, Dhaka

APPINDIX VII. BHPI, REVIEW BOARD (IRB) AND ETHICAL APPROVAL (BANGLADESH)

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

Ref:

Date: 20/08/2019

CRP-BHPI/IRB/08/19/1316

To,
Anil Rimal
5th Batch M.Sc. in Rehabilitation Science
Session: 2018-2019, Student ID 181180119
BHPI, CRP-Savar, Dhaka-1343, Bangladesh

Subject: Approval of thesis proposal **"Effect of Spencer's Muscle Energy Technique on Frozen shoulder patients attending at CRP, SAVAR"** by ethics committee.

Dear Anil Rimal
Congratulations,

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned thesis, with yourself, as the Principal Investigator. The Following documents have been reviewed and approved:

S.N.	Name of Documents
1.	Thesis Proposal
2.	Questionnaire (English and Bengali version)
3.	Information sheet & consent form.

The study involves the measurement of the effect of Spencer's muscle energy technique on pain, ROM and shoulder disability on frozen shoulder patients attending at CRP. The study compares it with conventional treatment protocol. One group will receive Spencer's muscle energy technique whereas other group receives conventional treatment. The intervention will take 30 minutes and provide 4 sessions. There is no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 8.30 AM on 17 February 2019 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain
Assistant Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404
E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd, www.crp-bangladesh.org

MASTER CHART

EXPERIMENTAL GROUP

S.N	AGE	SEX	PRE INTERVENTION								
			NPRS	SHOULDER ROM (DEGREE)				SPADI		
				FLEXION	ABDUCTION	INTERNAL ROTATION	EXTERNAL ROTATION	PAIN SCORE	DISABILITY SCORE	TOTAL SPADI
1	43	1	8	135	95	30	20	88	70	77
2	49	2	7	120	90	30	20	72	64	67
3	60	2	8	100	90	20	15	78	66	67
4	45	2	6	80	74	30	20	74	69	72
5	34	1	8	100	85	45	30	62	65	64
6	49	1	7	130	98	35	25	76	71	68
7	45	2	6	100	80	45	30	78	66	70
8	65	1	8	130	105	60	35	74	40	53
9	34	2	7	130	100	50	30	58	41	48
10	60	2	7	138	104	46	28	72	53	60
11	42	2	8	140	88	48	36	52	40	45
12	49	2	9	120	100	48	20	48	43	46
13	60	2	6	96	88	15	10	76	73	74
14	48	2	5	128	96	38	26	56	54	55
15	60	2	7	138	90	45	25	64	63	63
16	53	1	9	122	96	45	23	64	53	57
17	49	1	8	122	96	42	20	64	51	56
18	45	2	7	150	110	48	36	50	54	52
19	56	2	6	170	150	65	60	64	52	58
20	49	1	7	100	85	15	10	68	55	60

S.N	POST INTERVENTION							
	NPRS	SHOULDER ROM (DEGREE)				SPADI		
		FLEXION	ABDUCTION	INTERNAL ROTATION	EXTERNAL ROTATION	PAIN SCORE	DISABILITY SCORE	TOTAL SPADI
1	4	155	108	42	30	56	64	61
2	3	138	106	44	34	46	56	52
3	3	134	108	36	28	42	58	52
4	2	114	105	48	42	54	56	55
5	4	120	110	62	52	36	53	46
6	2	148	112	48	38	46	54	51
7	2	134	112	65	53	48	56	53
8	3	158	128	78	62	44	33	37
9	3	162	130	72	55	34	34	34
10	2	170	128	62	52	58	46	51
11	4	168	122	65	58	28	25	26
12	4	138	114	55	38	20	24	22
13	2	128	114	36	34	58	61	60
14	2	142	110	48	35	36	44	41
15	2	168	122	68	42	40	55	49
16	3	148	118	55	35	36	43	40
17	4	145	115	58	35	44	40	41
18	4	174	136	62	60	30	32	31
19	2	180	175	80	78	32	28	30
20	3	138	122	38	36	48	30	39

CONTROL GROUP

S.N	AGE	SEX	PRE INTERVENTION								
			NPRS	SHOULDER ROM (DEGREE)				SPADI		
				FLEXION	ABDUCTION	INTERNAL ROTATION	EXTERNAL ROTATION	PAIN SCORE	DISABILITY SCORE	TOTAL SPADI
21	60	1	8	120	90	25	15	48	50	48
22	40	2	7	165	140	60	50	34	24	29
23	60	1	8	80	80	25	20	60	60	60
24	30	2	7	80	80	25	30	58	59	59
25	55	2	9	110	105	38	20	40	43	42
26	57	2	8	125	93	35	10	52	49	50
27	42	1	9	110	100	40	30	34	38	36
28	38	2	8	110	100	28	10	50	46	48
29	42	2	6	90	80	30	25	58	50	54
30	55	2	5	110	95	25	20	56	50	53
31	48	1	7	100	85	25	10	60	49	53
32	60	2	6	105	85	35	20	60	55	57
33	43	1	6	120	98	35	25	62	53	56
34	45	1	7	108	95	35	18	54	51	52
35	42	1	7	100	92	32	20	55	53	54
36	52	2	8	110	100	35	15	58	54	56
37	55	1	8	108	100	32	25	62	55	59
38	42	1	7	118	110	35	22	58	55	57
39	54	2	9	100	85	30	15	56	52	54
40	62	1	6	105	92	28	18	62	56	59

S.N	POST INTERVENTION							
	NPRS	SHOULDER ROM (DEGREE)				SPADI		
		FLEXION	ABDUCTION	INTERNAL ROTATION	EXTERNAL ROTATION	PAIN SCORE	DISABILITY SCORE	TOTAL SPADI
21	5	138	122	44	38	26	34	30
22	3	175	162	75	70	20	15	18
23	5	118	112	45	38	30	34	32
24	4	110	106	42	45	34	42	38
25	6	165	155	65	30	26	34	30
26	5	160	130	50	25	36	39	38
27	5	155	138	65	48	22	29	26
28	5	145	138	46	35	34	34	34
29	3	118	112	45	38	36	35	36
30	2	145	125	43	38	34	38	36
31	4	138	128	48	35	36	31	33
32	3	135	125	60	48	38	43	41
33	3	165	132	58	48	36	40	38
34	4	145	132	62	45	40	39	39
35	3	135	128	55	42	38	40	39
36	4	138	128	60	30	35	43	37
37	4	136	128	60	45	38	45	42
38	4	156	138	62	48	32	40	36
39	5	128	120	52	32	34	38	41
40	4	138	122	43	35	40	44	42