International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 10 | Issue 4 | Oct - Dec - 2022
www.ijamscr.com

Research article ***Medical research***

Effectiveness of spencer muscle energy technique along with conventional therapy on improving shoulder functions in the subjects with stage 2 adhesive capsulitis

Dr. Jagarlamudi hari kishore babu[1], Dr. Yateendra putcha*

[1]Professor & HOD, Navodaya College of Physiotherapy, Raichur
2 Professor, Wellness College of Physiotherapy, Osmanabad,*

Corresponding Author: Yateendra Putcha

ABSTRACT

Background and Objectives: Adhesive shoulder capsulitis or Arthrofibrosis commonly known as Frozen Shoulder, depicts a pathological process in which the body forms excessive scar tissue or adhesions in the capsule around the Glenohumeral Joint, leading to stiffness, pain and dysfunction. The objective of this study was to evaluate the significant difference between Spencer Muscle Energy Technique and Conventional Therapy in improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.
Design: Randomized pretest-posttest control group design
Methods: 30 subjects who fulfilled the inclusion and exclusion criteria were selected for the study and 15 subjects were randomly assigned to each of the two groups. Interventions conducted on the subjects were explained to them and written consent was taken from all the subjects with Stage 2 Adhesive Capsulitis. All the subjects were assessed for pain and disability of shoulder by SPADI, Range Of Motion by Universal Goniometry and pain by SF-MPQ. Group A (experimental) received Spencer Muscle Energy Technique along with Conventional Therapy and Group B (control) received Conventional Therapy. Pretest was conducted before the intervention in first week and posttest after 6 weeks of intervention.
Results: There were significant differences in pain ($p=0.035>0.005$) and disability ($p=0.000<0.005$) of SPADI, abduction ($p=0.000<0.005$), internal rotation ($p=0.000<0.005$), external rotation ($p=0.000<0.005$) in Range Of Motion and SF-MPQ ($p=0.000<0.005$) within the groups and no significant differences between the groups.
Conclusion: The result of this study showed that interventions given to both the groups showed improvement in SPADI, Range Of Motion and SF-MPQ, which revealed that the applied exercises had a positive effect on improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

Keywords: Spencer Muscle Energy Technique, Adhesive Capsulitis, Conventional Therapy.

INTRODUCTION

The Spencer technique is a standardized series of treatments with broad application to diagnose, treat and establish prognosis for restricted mobility in shoulder. It was developed by Spencer in 1961. This approach is a well-known Osteopathic Manipulative Technique that focuses on mobilization of the glenohumeral and scapulothoracic joints. This Articulatory Technique is performed by osteopathic practitioners and trained osteopathic physicians. It is a multistep technique that combines Spencer's positioning, sequencing, slow stretching of the shoulder complex within pain-free limits done by physical therapist while incorporating muscular energy with post-isometric contraction and relaxation. It serves to enhance the mobility of glenohumeral and scapulothoracic joints by soft tissue stretching and fluid mobilization. It is sequenced to improve shoulder complex mobility by first treating most pain-free followed by most restricted motions. Spencer muscle energy technique (SMET) attempts to re-establish functional relationship between soft

and articular tissues of the shoulder region, minimizes inflammatory and later developing fibrotic process, and restores arterial, venous, and lymphatic flow. Like other OMT procedures, it not only restores joint functions, but enhances positive well-being and full expression of a patient's life. In this technique, passive, smooth, rhythmic motion of the shoulder joint is done by the therapist to stretch contracted muscles, ligaments, and capsule. The therapist uses low velocity and moderate to high amplitude forces to carry a dysfunctional joint through its full range of motion, with the therapeutic goal of increasing range of motion. This technique involves repeatedly taking a restricted joint into and out of its barrier to reduce a restriction. Studies have shown the effect of the Spencer technique on improving mobility and functional ability in subjects with frozen shoulders. When used in diagnosis, the various steps of the technique will evaluate the separate ranges of motion of the shoulder both as to the degree of motion before pain occurs and the total permitted range of motion. This will also help to identify the shoulder structures in which a pathologic lesion exists. It is an excellent tool for establishing the prognosis in a patient with shoulder dysfunction[1].

Historical Development of Technique

In his initial description, Spencer pointed out that he had special success applying a series of manipulative treatments to baseball players and others who had suffered trauma to the shoulder. He indicated that the treatment series was most effective in patients with diminished shoulder motion and pain with or without calcific infiltration demonstrated by x-ray studies. He suggested that the important pathologic conditions leading to pain and motion loss were bursitis and tenosynovitis involving any of the shoulder soft tissue structures.

In 1916, Spencer described six steps. The first group of three steps dealt only with flexion, extension, and some abduction of the shoulder. Spencer pointed out that in aggravated cases the patient could tolerate a little more. The second group of the series addressed limitations of abduction, adduction, and external and internal rotation of the shoulder. These latter motion restrictions tend to have an early onset after injury and tend to persist long after pain and other motion limitations have resolved. In all steps or segments of his series, Spencer had the patient lie on the side with the shoulder to be treated uppermost. He faced the patient and placed the hand nearest the patient's head firmly on the superior aspect of the shoulder so as to fix it on the superolateral part of the patient's thorax. The fixed shoulder girdle provided a resistant structure against which to stretch the soft tissues bridging the glenohumeral articulation as the arm was used as a long lever. For the first two steps, the patient's elbow was maintained in a flexed position. The steps are as follows:

- Step 1 - The arm, extended at the elbow, was fully extended, and then flexed, at the shoulder.
- Step 2 - The patient's arm, with the elbow flexed, was abducted, and moved through the widest circle possible (circumduction of the shoulder).
- Step 3 - The patient's elbow was extended, and the arm was carried "as high in front of the patient as possible" (shoulder flexion with the elbow straight). Treatment in the initial care of the severely involved patient stopped here. With the reduction of swelling and pain, the final three steps were added to the treatment.
- Step 4 - This step was the same as step 2, that is, circumduction, except that the patient's elbow was fully extended.
- Step 5 - The patient rested the hand of the arm being treated on the most cephalic ward forearm of the operator. The other hand of the operator was used to force the patient's elbow downwards towards the table, then towards the head of the table, producing, in sequence, adduction, external rotation, and flexion of the shoulder.
- Step 6 - The patient's elbow was partially flexed with the hand placed behind the flank. That hand became a pivot when the operator grasped the patient's elbow forcing it ventrally, carefully, against a fixed shoulder. This step introduced slight abduction and rather forceful internal rotation at the shoulder joint2.

Then the changes began. When Spencer presented shoulder treatment at the American Osteopathic Association meeting in Toronto, Ontario, Canada, in July 1925, there were seven steps in the series. The patient and the operator remained positioned as in the 1916 series. Changes by others St Clair was a classmate and close friend of Spencer's. In his version of Spencer's series, he includes five steps, all of which are similar to those described by Spencer but in a different order. Rubenstein included only three of the Spencer series of seven steps in his 1949 book.

The current "Seven steps of Spencer" appeared as early as 1953 in mimeographed class notes used by Lyman in his course in appendicular techniques for second-year students at the Philadelphia College of Osteopathic Medicine. This is the last time we find step 5 requiring adduction and external rotation. From 1974 to date, step 5 has been described first by Nicholas, then by Greenman, and by DiGiovanna and Schiowitz as producing, basically, abduction and internal rotation at the shoulder3.

The Kirksville College of Osteopathic Medicine included a description of Spencer technique (li la Nicholas) in the Outline of Osteopathic Manipulative Procedures (1979). Nicholas' paper from Osteopathic Annals was included in Selected Papers in Osteopathic Medicine distributed for student reading at the Chicago College of Osteopathic medicine in 1985 to 1986. An important historical note in the Nicholas article in Osteopathic Annals may explain why we find Spencer's technique mentioned in publications at the Philadelphia College of Osteopathic Medicine earlier than at other schools. He stated, "The 'Spencer Techniques' were reintroduced to the osteopathic profession by Angus G. Cathie, D.O., F.A.A.O., at the Philadelphia College of Osteopathic Medicine." This statement could account for the technique's reintroduction after a hiatus of more than 20 years. Because the description by Nicholas is the principal one in current osteopathic medical texts, rendition of his technique series was documented. His description is the same as that published by Spencer in 1926 with several minor exceptions, and one important one. Nicholas' procedure is reported as follows:

- **Step 1** - The patient's elbow is flexed, and the arm is carried in the horizontal plane into flexion and extension, especially extension.
- **Step 2** - The patient's elbow is extended, and the arm is carried into full flexion in the horizontal plane so that the patient's arm lies over the ear.

- **Step 3** - The patient's elbow is flexed, and the arm/shoulder is abducted to a right angle with the body. The elbow is carried in circles clockwise and counterclockwise so that first it makes small circles, then larger ones. Spencer's 1916 series step 2: Operator flexes patient's elbow and abducts shoulder with circumduction. (Step 4 in Spencer's 1926 series).
- **Step 4** - With the patient's elbow extended, step 3 is repeated.
- **Step 5** - The patient's elbow is flexed, so that the hand rests on the operator's arm holding the shoulder of the patient. With gentle upward pressure exerted on the patient's elbow, the physician swings toward the patient's head balancing weight from one foot to the other to get an easy rhythmic swing backward and forward. This manoeuvre is a marked alteration of Spencer's step 5, with abduction and internal rotation replacing the abduction and external rotation stretching, which are applied nowhere else in the treatment series.
- **Step 6** - The patient's elbow is flexed, the hand is placed just in back of the lower ribs, and the shoulder is abducted. The operator with one hand draws the shoulder forward against the resistance of the other hand on the front of the shoulder.
- **Step 7** - The position is as same as Spencer did in 1926, with the flexed elbow of the patient resting over the forearm of the operator. Nicholas' version requires the use of both the operator's hands to induce alternating traction and compression on the shoulder soft tissues in place of the traction and intermittent abduction described by Spencer.

The description by Greenman is much the same as that by Nicholas with the following exception: In step 1, Greenman gives equal importance to shoulder flexion and extension whereas both Spencer and Nicholas indicate the critical importance of stretching in extension. DiGiovanna and Schiowitz gave the same description of the technique given by Nicholas.

Recently, an important addition to the Spencer series of techniques has found universal acceptance. Practitioners are currently adding isotonic muscle energy treatment to each step of the Spencer series. This treatment combines Spencer's positioning sequence and its slow, intermittent stretching with patient active muscle energy technique. Clinically, we find that the combination of the two methods enhances both soft tissue stretching and fluid movement in the area being treated. This enhancement clearly adds to the effectiveness of treatment of the shoulder. In each step, muscle energy forces are applied after the parts have been moved against the restrictive barrier. The end result is that the patient has more motion with less pain sooner. This addition to the technique increases all ranges of motion by direct influence on the shoulder soft tissue components and perhaps through neural connections5, 6.

Adhesive Shoulder Capsulitis or Arthrofibrosis

Also commonly known as Frozen Shoulder, depicts a pathological process in which the body forms excessive scar tissue or adhesions in the capsule around the glenohumeral joint, leading to stiffness, pain and dysfunction7. The term Frozen Shoulder" was first introduced by Codman in 1934. He described Frozen Shoulder as a painful shoulder condition of insidious onset that was associated with stiffness and difficulty in sleeping on the affected side. [1]. Codman also identified the marked reduction in forward elevation and external rotation that are the hallmarks of the disease [2].8 Duplay first describes the symptoms in 1872 using the term 'periarthrite scapulohumerale' [3]. Neviaser coined the term 'Adhesive Capsulitis' after open surgery in affected shoulders.9 He observed a sound like adhesive tape being pulled off when he manipulated the Adhesive Capsule of the Shoulder.10, 11

In 1999, Finch University of Health Sciences/Chicago Medical School, North Chicago, Illinois, described that adhesive capsulitis has also been described as a condition of "unknown etiology characterized by gradually progressive, painful restriction of all joint motion . . . with spontaneous restoration of partial or complete motion over months to years".12

The incidence of Adhesive Capsulitis in the general population is approximately 3% to 5% but as high as 20% in patients with diabetes.13, 14 Idiopathic Adhesive Capsulitis often involves the nondominant extremity, although bilateral involvement has been reported in up to 40% to 50% of cases15. This condition most frequently affects persons aged 40 to 60 years and rarely occurs in persons younger than 40 years of age. Frozen Shoulder might affect both shoulders in up to 16% of patients; however, a relapse is uncommon. An increased incidence of AC has been noticed in patients with hyperthyroidism and hypertriglyceridemia16.

Adhesive Capsulitis is classified into two categories: primary which is idiopathic in origin and occur spontaneously without any specific trauma or inciting event and is characterized by painful restriction of all shoulder movements, both active and passive, or Secondary which occurs as a result of some identifiable disorder, such as diabetes mellitus, or due to any inciting event such as cardiac surgery or trauma.17,18 It can also be a severe complication after open or arthroscopic shoulder surgery, including rotator cuff repair and Shoulder Arthroplasty.

The four stages of a Frozen Shoulder are:

Stage 1 - "Painful shoulder"- Patients present with a primary complaint of shoulder pain, especially at night, although they have preserved motion. Arthroscopically, there is evidence of synovitis without adhesions or contractures.

Stage 2 - "Freezing Stage"- Patients begin to develop stiffness. Synovitis is again observed on arthroscopy, although there is also some loss of the axillary fold, suggestive of early adhesion formation and capsular contracture with chronic pain.

Stage 3 - "Frozen Stage"- Characterized by profound global loss of ROM and pain at the extremes of motion. During this stage, also known as the maturation stage, synovitis is resolved but the axillary fold is obliterated as a result of significant adhesions with rigid "end feel".

Stage 4 - "Chronic stage"/"Thawing Phase"- There is persistent stiffness but minimal pain as synovitis has resolved.

Advanced adhesions and restriction of the glenohumeral joint space are observed arthroscopically with progressive improvement in Range of Motion. Histologically, Stage I is characterized by inflammatory cell infiltration of the

synovium, Stage II by synovial proliferation and Stage III by dense collagenous tissue within the capsule, supporting the theory that inflammation leads to reactive fibrosis.

Patients with Frozen Shoulders exhibit significant deficits in shoulder kinematics, including increased elevation and upward scapular rotation. Eventually, patients with adhesive capsulitis develop the characteristic "Shrug Sign" during glenohumeral joint elevation, where the scapula migrates upward prior to 60 degrees of abduction. This indicates compensation due to lack of capsular extensibility as well as a change in the central nervous system motor patterning due to maladaptive movement. Patients with adhesive capsulitis may also develop adaptive postural deviations such as anterior shoulders or increased thoracic kyphosis as the function of the shoulder complex remains limited and painful.

The exact pathophysiology of Adhesive Capsulitis is unknown. The most commonly accepted hypothesis states that inflammation initially occurs within the joint capsule and synovial fluid. The inflammation is followed by reactive fibrosis and adhesions of the synovial lining of the joint. The initial inflammation of the capsule leads to pain, and the capsular fibrosis and adhesions lead to a decreased Range Of Motion.

Adhesive capsulitis has long been considered to be a primarily fibrotic disorder similar to Dupuytren's disease because the histology of affected specimens primarily shows fibroblasts mixed with type I and type III collagen. These fibroblasts were observed to transform into smooth muscle phenotype (myofibroblasts), which is assumed to be responsible for capsular contracture. There are altered levels of matrix metalloproteinases (MMPs), which are involved in scar tissue remodelling. Expression of MMP-1 and MMP-2 is lowered in patients with adhesive capsulitis; at the same time, expression of tissue inhibitor of metalloproteinase (TIMPs) such as TIMP-1 and TIMP-2 is elevated.

Bulgen in 1976 found HLA B27 more common in patients with adhesive capsulitis, but this has not been confirmed in subsequent studies. Rodeo et al. in 1997 demonstrated increased deposition of cytokines as transforming growth factor, platelet derived growth factor and tumor necrosis factor-alpha in the synovium and in the capsule of the adhesive capsulitis group compared to a control group. They postulated that cytokines might be involved in the fibrotic and inflammatory process. Especially the matrix-bound transforming growth factor beta may act as a persistent stimulus, resulting in a capsular fibrosis. Lundberg documented periarticular inflammatory changes and thickening of the joint capsule without intra-articular adhesions.28 Rizk ET al. discovered thickening and constriction of the capsule. Ozaki found a contracted and hypertrophied coracohumeral ligament. Neviaser described the hypothesis that the underlying pathological changes are synovial inflammation with subsequent reactive capsular fibrosis.

Those findings support the notion that adhesive capsulitis is the result of an imbalance between extracellular matrix tissue degradation, remodeling and regeneration. Future therapy may directly inhibit fibro genesis or promote remodeling of fibrotic tissue. Corroborating these are studies demonstrating elevated inflammatory cytokines including interleukin (IL)-1a, IL-1b, tumour necrosis factor (TNF)-a, cyclooxygenase (COX)-1 and COX-2 in capsular and bursal tissues of patients with adhesive capsulitis compared to controls.

Thus, it might be argued that adhesive capsulitis is primarily an inflammatory process that eventually leads to fibrotic changes. Almost all of the samples obtained from the rotator interval of patients with adhesive capsulitis contain inflammatory cells, including T cells, B cells, macrophages and mast cells. Mast cells are known to regulate fibroblast proliferation in vivo and may act as an intermediary between the inflammatory and subsequent fibrotic processes.

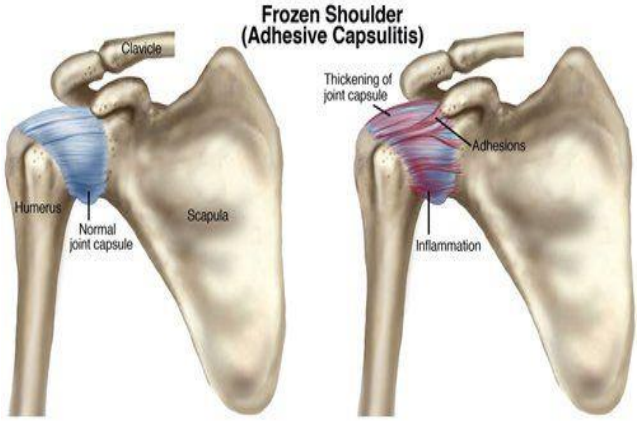
Recent studies have sought to link molecular pathogenesis with known risk factors and genetic susceptibility for adhesive capsulitis. Cytogenetic analysis study has revealed elevated fibro genic (MMP-3) as well as inflammatory (IL-6) cytokines in patients with adhesive capsulitis.

Ling et al. found that specific single peptide polymorphisms (SNP) of IL-6 (rs1800796 SNP) and MMP-3 (rs650108 SNP) are associated with severity and susceptibility of shoulder stiffness following rotator cuff repair, demonstrating a genetic predisposition for secondary adhesive capsulitis.

Kim et al. reported that intercellular adhesion molecule-1 (ICAM-1), a transmembrane protein on endothelial cells and leukocytes that facilitate leukocyte endothelial transmigration, is increased in capsular tissue, synovial fluid and serum of patients with adhesive capsulitis. Interestingly, the ICAM-1 level is also elevated in diabetes mellitus. This observation provides a potential molecular link between the two conditions.

This suggests concluded that both neoangiogenesis and neoinnervation occur in adhesive capsulitis, and the latter process may explain why adhesive capsulitis is unbearably painful. One key growth factor involved in adhesive capsulitis is TGF-b.

It is a condition of glenohumeral joint, in which there is restriction of active and passive ROM in capsular pattern i.e. external rotation and abduction are mostly restricted followed by internal rotation and flexion whereas extension is relatively free. Reduction of anterior joint capsule space indicates tightness of anterior capsule limiting shoulder external rotation most. Reduction of inferior redundant joint capsular fold limits shoulder abduction. Relatively less reduction of posterior joint capsule space indicates tightness of posterior capsule limiting shoulder internal rotation to lesser extent.



Patients with AC have difficulties in everyday activities (dressing, grooming, and performing overhead reaching activities and so on for a period of several months to several years) and shoulder pain disturbing sleep at night on the affected side, which is a key diagnostic sign. It is often regarded as a self-limiting disease that resolves between 1 and 3 years. However, various studies have shown that between 20% and 50% of patients may go on to develop long-lasting symptoms. In this patient population, both nonoperative and operative interventions are needed to ensure acceptable functional outcomes.38

Risk factors for Adhesive Capsulitis include- Female sex, age over 40 years, preceding trauma, HLA-B27 positivity and prolonged immobilization of the glenohumeral joint. It is estimated that 70% of patients with Adhesive Shoulder Capsulitis are Women. Additionally, men do not respond to treatments as well as women. Demographic studies have shown that most patients with Adhesive Capsulitis (84.4%) fall within the age range of 40 years to 59 years.39

A recent meta-analysis study by Prodromidis and Charalambous suggested a genetic predisposition to Adhesive Capsulitis, noting a higher predilection of this condition in white patients, patients with a positive family history, and patients with HLA-B27 positivity. Adhesive Capsulitis is associated with diabetes, thyroid disease, cerebrovascular disease, coronary artery disease, autoimmune disease and Dupuytren's disease. Interestingly, both type I and type II diabetic patients are at increased risk of developing Adhesive Capsulitis, with prevalence of 10.3% and 22.4%, respectively. Diabetic patients with Adhesive Capsulitis have worse functional outcomes compared to their nondiabetic counterparts.40

A nationwide population based study led by Huang et al. showed that, compared to the general population, patients with hyperthyroidism have 1. Times the risk of developing Adhesive Capsulitis.

Patients with cerebrovascular disease, especially those surgically treated for subarachnoid haemorrhage, are more susceptible to developing Adhesive Shoulder Capsulitis; in one prospective study of this high risk population, 23 of 91 patients (25.3%) developed Adhesive Capsulitis within 6 months.

Smith et al. showed that Dupuytren's disease was found in 52% of patients (30 of 58) with Adhesive Capsulitis. Although the prevalence of Adhesive Capsulitis is higher in patients with the associated conditions stated above, further studies are needed to determine why such relationships exist.41

Physical therapy is among the first-line therapeutic choices in adhesive capsulitis. Conventionally used physical therapy regimens in adhesive capsulitis are heat modalities, analgesic modalities (transcutaneous electrical nerve stimulation (TENS), mobilization techniques and exercises like Codman's pedular exercises, self-stretching exercises, capsular stretching's, wand exercises.42

Codman's exercises are those most frequently used to improve the range of motion. The emphasis in therapy is on passive stretching of the shoulder capsular contracture in all planes of motion. The literature on physical therapy in treating adhesive capsulitis is controversial and its efficacy has not been established. In a recently published review, it has been reported that physical therapy alone had little benefit in treating adhesive capsulitis. Although steroid injection was effective, the best approach was combination with physical therapy.43

Isidorus Jehaman, Sabirin Berampu conducted a study to find out the benefits of manual therapy and codman pendular in increasing the functional activity of frozen shoulder patients. Based on the results obtained during manual therapy and codman pendular exercises, it shows that the ability of the patient's shoulder functional activity has increased.47

Ultrasound (US), which is a deep heat modality, has been used for more than 60 years in clinics but the effects of US in pain, soft tissue lesions and musculoskeletal injuries remains questionable. US is effective in increasing the ROM of periarthritic shoulders. Collagen and tendon extensibility increases as temperature increases. As a result, stretching should begin during heating and continue as the tissue cools and sets. US was found to be more effective than placebo US in calcific tendonitis in a review about the effectiveness of therapeutic US, whereas in another review it was found to be ineffective in soft tissue disorders of the shoulder. 44

Shahbaz Nawaz Ansari, Lourdhuraj conducted a study to check the effectiveness between the treatment modalities of Ultrasound therapy and End range mobilization over Cryotherapy and Stretching as a treatment program in alleviating pain of patients with frozen shoulder. They concluded that Ultrasound therapy with end range mobilization produced a better result than cryotherapy with stretching in reducing pain and therefore can be recommended in the treatment of frozen shoulder.59

Range of motion exercises also contribute in improving joint and soft tissue mobility and decreases risk of adhesions and contracture formation. Stretching exercises given as home Programme were also helpful in breaking the collagen bonds and realignment of the fibres for permanent elongation or increased flexibility and mobility of the soft tissues that have adaptively shortened and become hypo mobile over time in Frozen Shoulder.45

Spencer MET is unique in its application as the client provides the initial effort while the practitioner facilitates the process. One of the main uses of this method is to normalize joint range, rather than increase flexibility, and techniques can be used on any joints with restricted Range of Motion (ROM) identified during the passive assessment.1, 46

It consisted of maintaining the shoulder joint into the restrictive barrier and creating isometric contraction of the muscles in each stage. Most of the force is applied at the end range of motion This technique increases pain free range of motion through stretching the tissues, enhancing lymphatic flow and stimulating increased joint circulation. The isometric variety of the Spencer technique was used as described by DiGiovanna et al. The post isometric contraction replication steps consisted of 3 cycles of isometric contraction (at 3-5 lb. subjective force) followed by a 2-second relaxation phase and subsequent movement of the joint to the new restrictive barrier.6

Mushyyaida Iqbal, Huma Riaz, conducted a study to compare the effects of Spencer muscle energy technique and passive stretching in adhesive capsulitis. Measurements were taken at baseline, 2nd and 4th week. They concluded that Spencer technique was found to be more effective than passive stretching in treating patients with adhesive capsulitis.49

Since, there are few number of studies investigating the effectiveness of Spencer Muscle Energy Technique in Stage 2 Adhesive Capsulitis of shoulder joint, the present study is being undertaken with the intention to evaluate the effectiveness of Spencer Muscle Energy Technique in stage 2 Adhesive Capsulitis of the shoulder joint.

PURPOSE OF THE STUDY

Frozen shoulder (FS) is, although known for more than a century, still an enigmatic and poorly defined shoulder disorder. The American Shoulder and Elbow Society (ASES) resulted in a consensus definition of adhesive capsulitis of shoulder as follows: “a condition characterized by functional restriction of both active and passive shoulder motion for which radiographs of the glenohumeral joint are essentially unremarkable”

Spencer MET is one of the special techniques of MET. It is unique in its application as the client provides the initial effort while the practitioner facilitates the process. It is a standardized series of shoulder treatments with broad application in diagnosis, treatment, and prognosis.

Since, there are few number of studies investigating the effectiveness of Spencer Muscle Energy Technique in Stage 2 Adhesive Capsulitis of shoulder joint, the present study is being undertaken with the intention to evaluate the effectiveness of Spencer Muscle Energy Technique in stage 2 Adhesive Capsulitis of shoulder joint.

OBJECTIVES

- To evaluate the effectiveness of Spencer Muscle Energy Technique along with Conventional Therapy on improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.
- To evaluate the effectiveness of Conventional Therapy on improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.
- To evaluate the significant difference in improving the effectiveness between Spencer Muscle Energy Technique and Conventional Therapy on improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

HYPOTHESIS

Null Hypothesis (H0): There is no significant difference in improving shoulder functions between group given Spencer Technique and group given Conventional Therapy.

Alternate Hypothesis (H1): There is a significant difference in improving shoulder functions between group given Spencer Technique and group given Conventional Therapy.

MATERIALS

- Couch
- Pillow
- Stool
- Therapeutic Ultrasound
- Ultrasonic gel
- Cotton
- Short Form MC Gill Pain Questionnaire chart
- Shoulder Pain and Disability Index chart
- Pen/pencil
- Goniometer
- Towel
- Wand
- Finger ladder/ wall

SOURCES OF DATA

For the purpose of data collection 30 patients within the age of 40-60 years diagnosed with Stage 2 Adhesive Capsulitis in the Department of Physiotherapy or referred to the Department of Physiotherapy in Navodaya Medical College, Hospital and Research Center, Raichur were selected.

RESEARCH DESIGN: Randomized pretest-posttest Control Group Design

SETTING OF THE STUDY: Navodaya Medical College, Hospital and Research Center, Raichur, which is 1200 bedded Multispecialty Hospital with fully equipped Orthopedic Physiotherapy Department.

VARIABLES:

Independent variables:

- Spencer Muscle Energy Technique
- Therapeutic Ultrasound
- Capsular Stretching
- Codman’s Pendular Exercises
- Self-Stretching exercises

Dependent variables:

- Short Form MC Gill Pain Questionnaire
- Shoulder Pain and Disability Index (SPADI)
- Goniometry

SAMPLE AND SAMPLING TECHNIQUES

30 patients within the age group of 40-60 years were selected on full filling the inclusion and exclusion criteria from the Department of Physiotherapy in NMCH. They were divided into two groups by Simple Random Sampling Technique.
Mean and SD of AROM abduction in pre and post-test in Spencer Muscle Energy Technique group were
64.95 ±11.42, 85.75±12.20
Pooled standard deviation= σ=12.20
Zα/2 =2.58 at 99% Confidence level
Zβ=1.282 at 90% power
d= mean difference= 20.8
Sample size formula

$n=2(Z\alpha/2 + Z\beta)\ 2\ (\sigma)\ 2/d2$

$N=2(2.54+1.282)2(12.20)2/\ (85.75-64.95)2$

n=11 is the minimum sample size. [Each group]

Therefore, total sample size consists of 30 subjects- 15 subjects in each group.

INCLUSION CRITERIA

- Subjects diagnosed with Adhesive Capsulitis (Stage 2)
- Both Genders
- Age group between 40-60 years
- Subjects with Adhesive Capsulitis with painful, stiff Shoulder for at least 3 months
- Subjects with Adhesive Capsulitis with limited Range Of Motion of shoulder
- Subjects with unilateral Adhesive Capsulitis
- Controlled Diabetes

EXCLUSION CRITERIA

- Subjects with recent history of shoulder joint surgeries were excluded
- Rheumatoid arthritis
- Osteo Arthritis of shoulder
- History of fracture around shoulder complex
- Osteoporosis or malignancies in the shoulder function
- Pain or disorders of cervical spine, elbow, wrist or hand
- Rotator cuff rupture
- Tendon calcification
- Subjects with paresthesia or loss of sensation
- Post traumatic subjects
- Adhesive Capsulitis secondary to Hyperthyroidism
- Subjects not willing to participate in the study

METHODS OF DATA COLLECTION

- Study consists of 30 subjects within the age group of 40-60 years. The subjects were screened for inclusion and exclusion criteria and those who fulfilled the criteria were considered for the study
- Pain was assessed by Short Form MC Gill Pain Questionnaire
- Pain and disability were assessed by Shoulder Pain and Disability Index (SPADI)
- Range of motion was assessed by Universal Goniometer

DURATION OF THE STUDY: The duration of the study was 12 months/ 1 year

STATISTICAL ANALYSIS

- After collecting data, it was entered in MS excel sheet version 10
- Quantitative data was expressed as mean and standard deviation
- Qualitative data was expressed as frequencies and percentages
- Analysis was done by using EPI info software version 7.0
- Paired t test was used to compare pre and post-tests between intra groups
- Independent sample t test was used to compare pre and post-tests between inter groups
- P<0.005 indicates significant, while P<0.001 indicates as highly significant

METHODOLOGY

30 subjects were selected for the study on full filling the inclusion and exclusion criteria with regardless of their gender and they were divided into two groups by simple random sampling technique. Assessment using the outcome measures were done before and after the program schedule of 6 weeks. Duration of treatment course is 6 weeks.
They were divided into two groups
Experimental group: 15 subjects received Spencer Muscle Energy Technique along with Conventional Therapy
Control group: 15 subjects received Conventional Therapy
An informed written consent was taken from all individuals
Brief explanation of procedure was given to the subjects after obtaining the informed consent.
PROCEDURE:
EXPERIMENTAL GROUP: 15 subjects received Spencer Muscle Energy Technique along with Conventional Therapy. This technique included:
SPENCER MUSCLE ENERGY TECHNIQUE-
Spencer Muscle Energy Technique included seven series of steps of mobilization to the glenohumeral joint.
Those steps were as follow:

STEP 1: EXTENSION

Position: Patient was in side-lying position with affected shoulder uppermost. Therapist stood 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 and oscillations were given for 30 seconds. 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 3 to 4 times.

STEP 2: FLEXION

Position: 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 patients shoulder in horizontal plane with elbow extension, until end range with barrier was felt and oscillations were given for 30 seconds. 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.

STEP 3: CIRCUMDUCTION WITH COMPRESSION

Position: 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 counter clockwise direction with slight compression on shoulder joint for 15 times each/30 seconds. The circle size of circumduction was gradually increased with each circular motion.

STEP 4: CIRCUMDUCTION WITH TRACTION

Position: 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 counter clockwise direction with slight traction on shoulder joint for 15 times each/30 seconds. The circle size of circumduction was gradually increased with each circular motion.

STEP 5: A. ABDUCTION WITH INTERNAL ROTATION

Position: 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 (cephalic) pressure on elbow to increase abduction till end range was felt and oscillations were given for 30 seconds. Patient was instructed to push or contract (50 % of maximum contraction) at restricted barrier 25 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 3 to 4 times.

STEP 5: B. ADDUCTION WITH EXTERNAL ROTATION

Position: 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 3 to 4 times.

STEP 6: INTERNAL ROTATION

Position: 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 and oscillations were given for 30 seconds. 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 3 to 4 times.

STEP 7: TRACTION OF DELTOID

Position: 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 3 to 4 times.

Duration of oscillations: 30 seconds
Duration of muscle energy technique: 10 seconds
Frequency of these steps: 3/4 times a day, 5 days per week for 6 weeks

CONVENTIONAL THERAPY

Same treatment was followed as that of the control group.
CONTROL GROUP: 15 subjects received Conventional Therapy.
These includes:

ULTRASOUND THERAPY

Treatment parameters of ultrasound:
Mode: continuous mode
Frequency: 1.0 MHz
Intensity: 1.5 W/cm2
Treatment time: 10 minutes
Coupling media: ultrasonic gel
Technique: direct contact with small overlapping circular strokes
Patient position for ultrasound therapy:
Patient was in comfortably sitting position. After coating the skin with an ultrasonic gel, Therapeutic Ultrasound was delivered by moving the applicator over the anterior, superior and posterior regions of the target joint in slow, overlapping strokes.

Duration of treatment: 5 days per week for 6 weeks.

CAPSULAR STRETCHING

- The glenohumeral joint capsule has a significant degree of inherent laxity with a surface area that is twice that of the humeral head.
- Subjects received treatment with moist pack for 10 minutes followed by capsular stretching for the anterior, inferior and posterior capsules of the shoulder.
- To stretch the anterior capsule the subject was positioned either in side lying with the affected arm upwards or in high sitting and the shoulder and arms were brought backwards into extension and this stretch was maintained for a minimum of 30 seconds and maximum duration up to the point of pain experienced by the patient. Posterior capsule stretching was performed with the subject in supine position and therapist performing cross body adduction. Antero-inferior capsule was stretched with the subject in supine position.
- To stretch the anteroinferior capsule the affected arm was taken towards the extreme of attainable elevation and counter pressure was maintained at the patient's sternum to prevent spinal extension. Each stress was gentle but firm and not released until pain rather than discomfort is experienced.
- Capsular stretching was followed by 10 minutes of icing to prevent post exercise muscle soreness.

Duration of stretching: 15-20 seconds
Frequency of stretching: 5 repetitions per set, 1 set per session, 5 session per week, for 6 weeks.

CODMAN'S PENDULAR EXERCISES

1. Patient was standing beside a table with the hand of his/her unaffected shoulder on the table and feet slightly wider than shoulder-width apart.
2. Patient was instructed to bend at the hips approximately 75 to 90 degrees and let his/her affected arm hang down toward the floor.
3. Patient had to shift his/her weight side to side, letting the arm swing freely side to side.
4. Patient shifted his/her weight forward and backward, letting the arm swing freely front to back.
5. Once the patient felt comfortable with these movements, he/she moved the body so that his/her arm swings in a circle, being careful not to use the shoulder muscles to create movement. The circles had to be kept small, less than 8 inches.
6. It was continued for 30 seconds. Each day, the time was increased until the subject could do for 3 to 5 minutes.
7. These exercises were repeated 5 times per day.

SELF STRETCHING EXERCISES

WALL STRETCH

Patient stood facing a wall at a 1-foot distance and touched the wall at his/her waist level with fingers of his/her affected arm and walk the fingers up the wall like a spider crawl to the point he/she was able to comfortably raise the arm.

Another variation of this exercise was standing sideways to the wall and touched the wall with his/her arms at her/his waist level with elbows slightly flexed and then walked the fingers up the wall. He/she may change the angle of the arm according to his/her comfort. This was repeated 10-15 times twice a day and should be held for 5-10 seconds.

TOWEL STRETCH

Patient held one end of a towel behind his/her back and grab the other end with another arm. With the towel placed in a horizontal position, patient tried to pull the affected arm upwards with the unaffected arm pulling the towel. This was repeated for 10 -15 times twice a day and should be held for 5-10 seconds.

CROSS BODY REACH

Patient was positioned in sitting or standing. Patient used his/her good arm to lift his/her affected arm at the elbow, and brought it up and across the body, exerted gentle pressure to stretch the shoulder. The stretch was held for 15 to 20 seconds. This was done 10 to 15 times, twice a day and should be held for 5-10 seconds. After this exercise, if patient experienced pain and soreness in affected shoulder, they were asked to place a cold pack for 10 to 15 minutes within 30 minutes.

DOOR LEAN

Patient was instructed to stand in a doorway with both his/her arms on the wall slightly above his/her head. Then he/she slowly leans forward until he/she felt a stretch in front of his/her shoulders. The stretch was held for 15-30 seconds and repeated 3 times for twice a day and should be held for 5-10 seconds.

WAND EXERCISES

FLEXION: This exercise was performed in lying or standing upright position. Holding a wand in both hands, palms down, patient was instructed to stretch his/her arms by lifting them over the head, keeping arms straight. He/she should hold for 5 sec and return to the starting position. This was repeated 10-15 times twice a day.

EXTERNAL ROTATION

This exercise was performed in sitting or lying on the back with both the elbows at a right angle and holding a stick with both hands. Patient was instructed to push wand with the help of both the hands in order to move the arm outwards. This stretch was held for 5 secs and repeated for 10-15 times twice a day

.

EXTENSION

Patient was instructed to stand holding the wand behind his/her back with elbows straight and lift the wand upwards away from the body. This position was held for 5 secs and return to the starting position. This was repeated for 10-15 times twice a day.

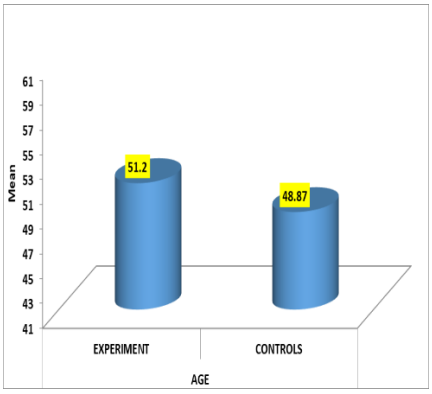
RESULTS

A randomized control trial consisting of 30 patients were randomized into two groups with 15 subjects in Experimental group- A (Spencer Muscle Energy Technique along with Conventional Therapy) and other 15 subjects in Control group – B (Conventional Therapy) to study the significant difference between the two groups receiving treatment.

Table 1: Distribution of study subjects according to age

Group Statistics						
	GROUP	**N**	**Mean**	**Std. Deviation**	**" t " Test**	**P Value**
AGE	EXPERIMENTAL	15	51.2	5.240	1.200	0.240
	CONTROLS	15	48.87	5.410		

The age of the participants of experimental group showed a mean value of 51.2 and standard deviation of 5.240, while those of the control group showed a mean value of 48.87 and standard deviation of 5.410.
There is no statistically significant difference between ages of both experimental and control groups.

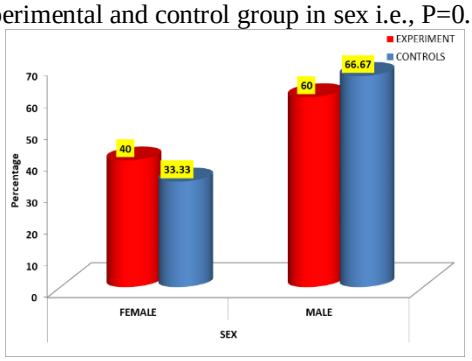


Graph 1: Bar diagram showing the distribution of study subjects according to age

Table 2: Distribution of study subjects according to sex

		GROUP				CHI-SQUARE	P VALUE
		EXPERIMENTAL		CONTROL			
		NO.	%	NO.	%		
SEX	FEMALE	6	40	5	33.33	0.144	0.705
	MALE	9	60	10	66.67		
TOTAL		15	100	15	100		

Majority are male subjects in experimental group i.e., 9(60%) and majority are male subjects in control group i.e., 10 (67%).
There is no significance found between experimental and control group in sex i.e., P=0.705>0.005.

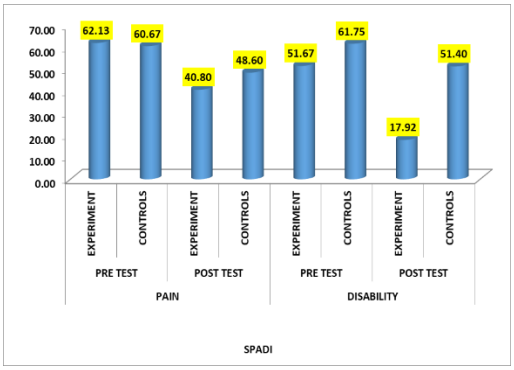


Graph 2: Bar diagram showing the distribution of study subjects according to sex

Table 3: Comparison of pre-test and post-test of Shoulder pain and disability index in experimental group and control group

SPADI		GROUP	N	Mean	Std. Deviation	Std. Error Mean	" t " test	P Value
PAIN	PRE TEST	EXPERIMENTAL	15	62.13	9.546	2.465	0.357	0.724
		CONTROL	15	60.67	12.732	3.287		
	POST TEST	EXPERIMENTAL	15	40.80	9.002	2.324	-2.216	**0.035**
		CONTROL	15	48.60	10.239	2.644		
DISABILITY	PRE TEST	EXPERIMENTAL	15	51.67	17.000	4.389	-2.169	**0.039**
		CONTROL	15	61.75	5.935	1.532		
	POST TEST	EXPERIMENTAL	15	17.92	5.182	1.338	-17.773	**0.000**
		CONTROL	15	51.40	5.136	1.326		

The pre-test mean of pain in experimental group is 62.13 with standard deviation of 9.546 and standard error mean of 2.465 and in control group is 60.67 with standard deviation of 12.732 and standard error mean of 3.287.
The pre-test mean of disability in experimental group is 51.67 with standard deviation of 17.000 and standard error mean of 4.389 and in control group is 61.75 with standard deviation of 5.935 and standard error mean of 51.40.
The post-test mean of pain in experimental group is 40.80 with standard deviation of 9.002 and standard error mean of 2.324 and in control group is 48.60 with standard deviation of 10.239 and standard error mean of 2.644.
The post-test mean of disability in experimental group is 17.92 with standard deviation of 5.182 and standard error mean of 1.338 and in control group is 51.40 with standard deviation of 5.136 and standard error mean of 1.326.
There is statistically no significant difference in pre-test mean in pain in experimental and control groups (P=0.724>0.005), whereas there is statistically significant difference in pre-test mean in experimental and control groups (P=0.039>0.005)
There is statistically significant difference in post-test mean in pain and disability of experimental and control groups (P=0.035>0.005) and (P=0.000>0.005).



Graph 3: Bar diagram showing comparison of pre-test and post-test in shoulder pain and disability index in experimental and control groups

Table 4: Comparison of pre-test and post-test in range of motion in experimental and control groups

RANGE OF MOTION		GROUP	N	Mean	Std. Deviation	Std. Error Mean	" t " test	P Value
ABDUCTION	PRE TEST	EXPERIMENTAL	15	110.00	18.613	4.806	1.016	0.318
		CONTROL	15	104.00	13.293	3.432		
	POST TEST	EXPERIMENTAL	15	134.80	9.850	2.543	5.53	**0.000**
		CONTROL	15	110.40	13.963	3.605		
INTERNAL ROTATION	PRE TEST	EXPERIMENTAL	15	33.73	7.314	1.888	2.776	**0.010**
		CONTROL	15	25.87	8.184	2.113		
	POST TEST	EXPERIMENTAL	15	53.33	7.943	2.051	6.884	**0.000**
		CONTROL	15	33.07	8.181	2.112		
EXTERNAL ROTATION	PRE TEST	EXPERIMENTAL	15	37.60	5.552	1.434	1.749	0.091
		CONTROL	15	31.87	11.413	2.947		
	POST TEST	EXPERIMENTAL	15	55.73	3.712	0.958	6.756	**0.000**
		CONTROL	15	40.00	8.220	2.122		

The pre and post-test mean of internal rotation in experimental group is 33.73±7.314 and 53.33±7.943 and standard error mean of 1.888 and 2.051

The pre and post-test mean of external rotation in experimental group is 37.60±5.552 and 55.73±3.712 with standard deviation of and standard error mean of 1.434 and 0.958.

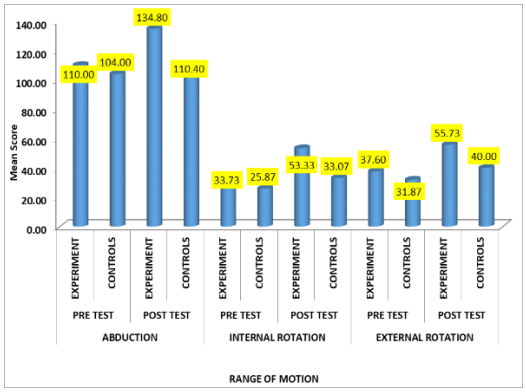
The pre and post-test mean of abduction in control group is 104.00±13.293 and 110.40±13.963 and standard error mean of 3.423 and 3.605

The pre and post-test mean of internal rotation in control group is 25.87±8.184 and 33.07±8.181 and standard error mean of 2.113 and 2.112

There is no statistically significant difference in pre-test in abduction and external rotation of experimental and control group (P=0.318>0.005) and (P=0.091>0.005), whereas pre-test in rotation is statistically significance is seen (P=0.010>0.005).

There is statistically significant difference in post-test in abduction, internal rotation and external rotation of experimental and control groups (P=0.000<0.005), (P=0.000<0.005) and (P=0.000<0.005).

EXPERIMENTAL GROUP			Mean	N	Std. Deviation	" t " test	P Value
SPADI	PAIN	PRE TEST	62.13	15	9.546	18.699	**0.000**
		POST TEST	40.80	15	9.002		
	DISABILITY	PRE TEST	51.67	15	17.000	9.928	**0.000**
		POST TEST	17.92	15	5.182		

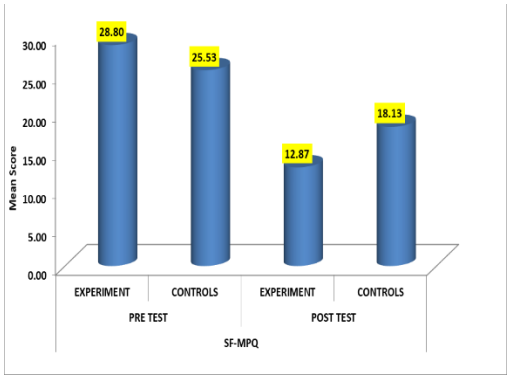


Graph 4: Bar diagram showing comparison in pre-test and post-test in range of motions of shoulder in experimental and control groups

Table 5: Comparison of pre-test and post-test in SF-MPQ in experimental and control groups

		GROUP	N	Mean	Std. Deviation	Std. Error Mean	" t " test	P Value
SF-MPQ	PRE TEST	EXPERIMENTAL	15	28.80	3.189	0.823	2.838	**0.008**
		CONTROL	15	25.53	3.114	0.804		
	POST TEST	EXPERIMENTAL	15	12.87	3.523	0.910	-4.486	**0.000**
		CONTROL	15	18.13	2.875	0.742		

The pre-test and post-test mean in SF-MPQ in experimental group are 28.80±3.189 and 12.87±3.523 and standard error mean are 0.823 and 0.910
The pre-test and post-test mean in SF-MPQ in control group are 25.53±3.114 and 18.13±2.875 and standard error mean are 0.804 and 0.742
There is statistically significant difference in SF-MPQ in both experimental and control groups (P=0.008>0.005) and (P=0.000>0.005)



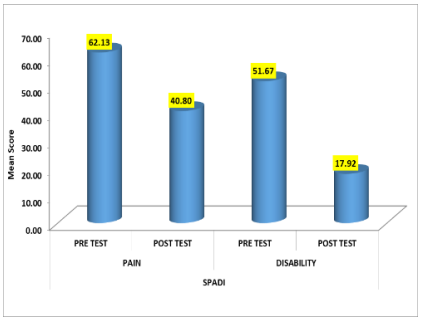
Graph 5: Bar diagram showing comparison of pre-test and post –test in SF-MPQ in experimental and control groups

Table 6: Comparison of pre-test and post-test of pain and disability in experimental group

EXPERIMENTAL GROUP		N	Mean	Std. Deviation	" t " test	P Value
ABDUCTION	**PRE TEST**	**15**	**110**	**18.613**	**-7.682**	**0.000**
	POST TEST	**15**	**134.80**	**9.850**		

The pre-test and post-test mean of pain in experimental group are 62.13±9.546 and 40.80±9.002
The pre-test and post-test mean of disability in experimental group are 51.67±17.000 and 17.92±5.182

There is statistically significant difference between pre-test and post-test mean of pain and disability in experimental group (P=0.000<0.005)

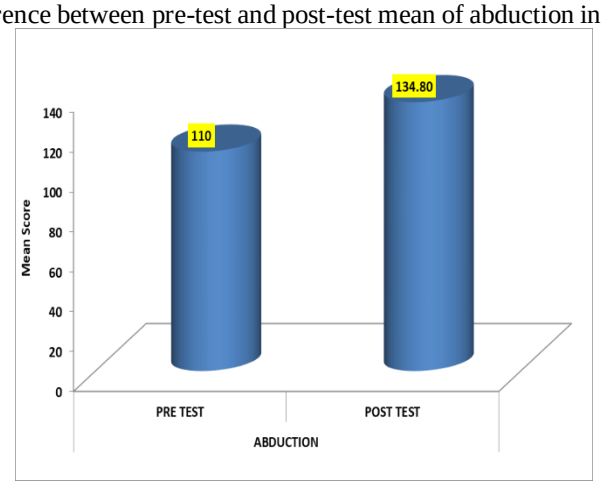


Graph 6: Bar diagram showing comparison of pre-test and post-test of pain and disability in experimental group

Table 7: comparison of pre-test and post-test of abduction in experimental group

EXPERIMENTAL GROUP		N	Mean	Std. Deviation	" t " test	P Value
ABDUCTION	PRE TEST	15	110	18.613	-7.682	0.000
	POST TEST	15	134.80	9.850		

The pre-test mean of abduction in experimental group is 110±18.613
The post-test mean of abduction in experimental group is 134.80±9.850
There is statistically significant difference between pre-test and post-test mean of abduction in experimental group (P=0.000<0.005)

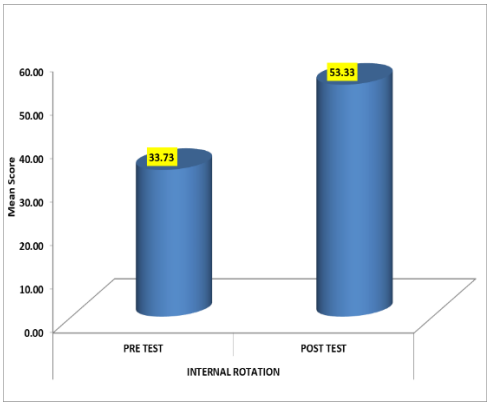


Graph 7: Bar diagram showing comparison of pre-test and post-test of abduction in experimental group

Table 8: Comparison of pre-test and post-test of internal rotation in experimental group

EXPERIMENTAL GROUP		N	Mean	Std. Deviation	" t " test	P Value
INTERNAL ROTATION	PRE TEST	15	33.73	7.314	-14.280	**0.000**
	POST TEST	15	53.33	7.943		

The pre-test mean of internal rotation in experimental group is 33.73±7.314
The post-test mean of internal rotation in experimental group is 53.33±7.943
There is statistically significant difference between pre-test and post-test mean of internal rotation in experimental group (P=0.000<0.005)

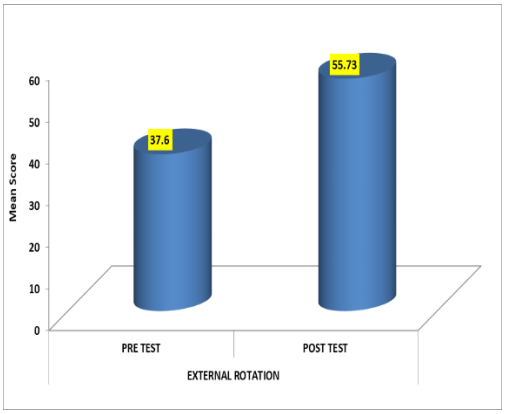


Graph 8: Bar diagram showing comparison of pre-test and post-test of internal rotation in experimental group

Table 9: comparison of pre-test and post-test of external rotation in experimental group

EXPERIMENTAL GROUP		N	Mean	Std. Deviation	" t " test	P Value
EXTERNAL ROTATION	PRE TEST	15	37.6	5.552	-12.796	**0.000**
	POST TEST	15	55.73	3.712		

The pre-test mean of external rotation in experimental group is 37.6±5.552
The post-test mean of external rotation in experimental group is 55.73±3.712
There is statistically significant difference between pre-test and post-test mean of external rotation in experimental group (P=0.000<0.005)

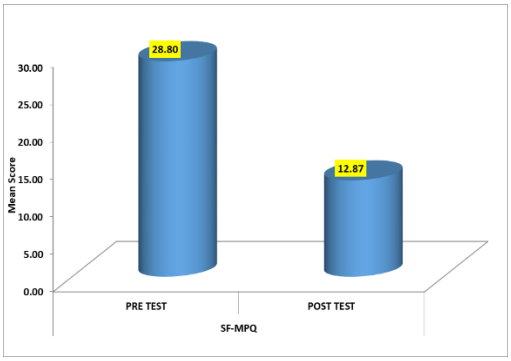


Graph 9: Bar diagram showing comparison of pre-test and post-test of external rotation in experimental group

Table 10: comparison of pre-test and post-test of SF-MPQ in experimental group

EXPERIMENTAL GROUP		N	Mean	Std. Deviation	" t " test	P Value
SF-MPQ	PRE TEST	15	28.80	3.189	13.976	**0.000**
	POST TEST	15	12.87	3.523		

The pre-test mean of SF-MPQ in experimental group is 28.80±3.189
The post-test mean of SF-MPQ in experimental group is 12.87±3.523
There is statistically significant difference between pre-test and post-test mean of SF-MPQ in experimental group (P=0.000<0.005)

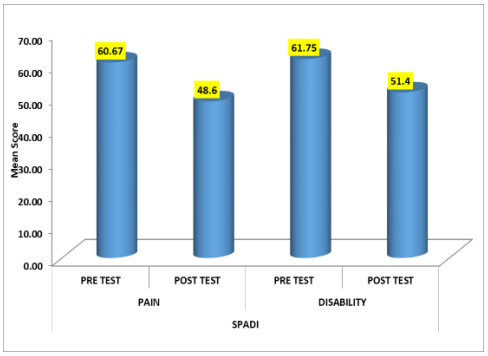


Graph 10: Bar diagram showing comparison of pre-test and post-test of SF-MPQ in experimental group

Table 11: comparison of pre-test and post-test of pain and disability in control group

			Mean	N	Std. Deviation	" t " test	P Value
SPADI	PAIN	PRE TEST	60.67	15	12.732	18.542	**0.000**
		POST TEST	48.6	15	10.239		
	DISABILITY	PRE TEST	61.75	15	5.935	29.081	**0.000**
		POST TEST	51.4	15	5.136		

The pre-test and post-test mean of pain in control group are 60.67±12.732 and 48.6±10.239
The pre-test and post-test mean of disability in control group are 61.75±5.935 and 51.4±5.136
There is statistically significant difference between pre-test and post-test in pain and disability in control group (P=0.000<0.005)

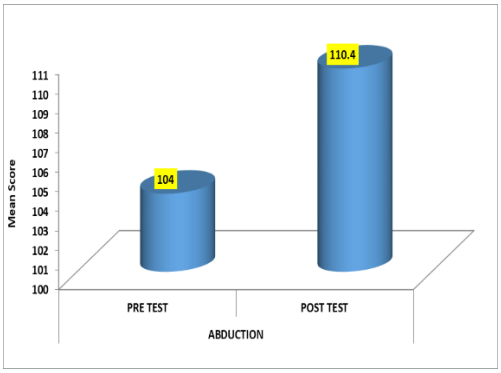


Graph 11: Bar diagram showing comparison of pain and disability in control group

Table 12: comparison of pre-test and post-test of abduction in control group

CONTROL GROUP		Mean	N	Std. Deviation	" t " test	P Value
ABDUCTION	PRE TEST	104	15	13.293	-7.533	**0.000**
	POST TEST	110.4	15	13.963		

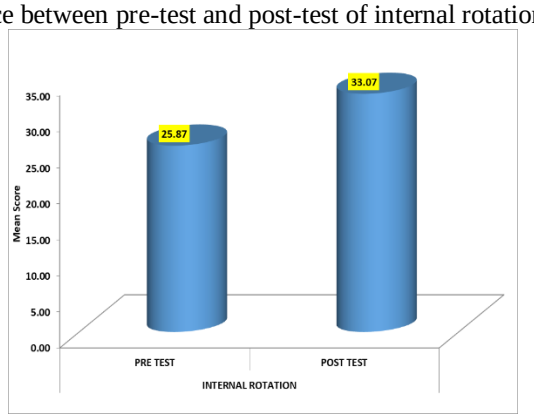
The pre-test mean of abduction in control group is 104±13.293
The post-test mean of abduction in control group is 110.4±13.963
There is statistically significant difference between pre-test and post-test mean of abduction in control group (P=0.000<0.005)



Graph 12: Bar diagram showing comparison of pre-test and post-test of abduction in control group

CONTROL GROUP		Mean	N	Std. Deviation	" t " test	P Value
INTERNAL ROTATION	PRE TEST	25.87	15	8.184	-12.096	**0.000**
	POST TEST	33.07	15	8.181		

The pre-test mean of internal rotation in control group is 25.87±8.184
The post-test mean of internal rotation in control group is 33.07±8.181
There is statistically significant difference between pre-test and post-test of internal rotation in control group (P=0.000<0.005)

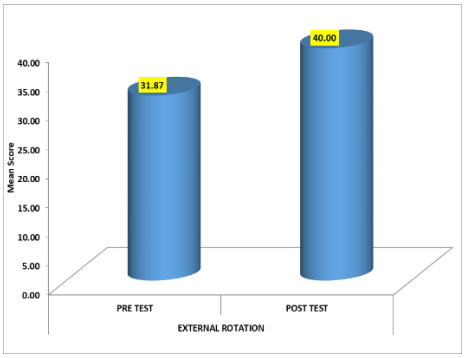


Graph 13: Bar diagram showing comparison of pre-test and post-test of internal rotation in control group

Table 14: comparison of pre-test and post-test of external rotation in control group

CONTROL GROUP		Mean	N	Std. Deviation	" t " test	P Value
EXTERNAL ROTATION	PRE TEST	31.87	15	11.413	-6.633	**0.000**
	POST TEST	40.00	15	8.220		

The pre-test mean of external rotation in control group is 31.87±11.413
The post-test mean of external rotation in control group is 40.00±8.220
There is statistically significant difference between pre-test and post-test mean of external rotation in control group (P=0.000<0.005).

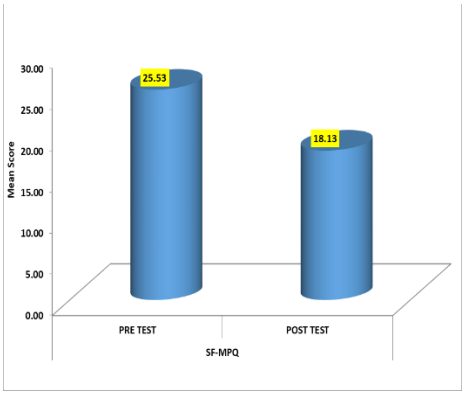


Graph 14: Bar diagram showing comparison of pre-test and post-test of external rotation in control group

Table 15: comparison of pre-test and post-test of SF-MPQ in control group

CONTROL GROUP		Mean	N	Std. Deviation	" t " test	P Value
SF-MPQ	PRE TEST	25.53	15	3.114	6.195	**0.001**
	POST TEST	18.13	15	2.875		

The pre-test mean of SF-MPQ in control group is 25.53±3.114
The post-test mean of SF-MPQ in control group is 18.13±2.875
There is statistically significant difference between pre-test and post-test mean of SF-MPQ in control group (P=0.001<0.005)



Graph 15: Bar diagram showing comparison of pre-test and post-test of SF-MPQ in control group

DISCUSSION

The principal idea of this research study was to evaluate the effectiveness of Spencer Muscle Energy Technique along with Conventional Therapy on improving shoulder functions in the subjects with Stage 2 Adhesive Capsulitis. The study was conducted on 30 subjects having Stage 2 Adhesive Capsulitis, which were randomly divided into two groups. Group A (Experimental group) received Spencer Muscle Energy Technique along with Conventional Therapy and Group B (Control group) received Conventional Therapy. Pain and Disability of Shoulder was measured by Shoulder Pain and Disability Index (SPADI), Short Form MC Gill Pain Questionnaire and Range of Motion by measured by Universal Goniometer. We tested the hypothesis that there will be significant difference between Spencer Muscle Energy Technique and Conventional Therapy on the subjects with Stage 2 Adhesive Capsulitis.

After 6 weeks of Spencer Muscle Energy Technique and Conventional Therapy it led to a significant difference in improving shoulder functions. All three scales showed improvement in pre and posttest scorings. (p=<0.001)

The Spencer Technique is a standardized series of treatments with broad application to diagnose, treat and establish prognosis for restricted mobility in shoulder. It was developed by Spencer in 1961. This approach is a well-known Osteopathic Manipulative Technique that focuses on mobilization of the glenohumeral and scapulothoracic joints. This Articulatory technique is performed by osteopathic practitioners and trained osteopathic physicians. It is a multistep technique that combines Spencer's positioning, sequencing, slow stretching of the shoulder complex within pain-free limits done by physical therapist while incorporating muscular energy with post-isometric contraction and relaxation. It serves to enhance mobility of glenohumeral and scapulothoracic joints by soft tissue stretching and fluid mobilization. It is sequenced to improve shoulder complex mobility by first treating most pain-free followed by most restricted motions.

Raksha, et al, conducted a study to compare the Effect of Spencer Muscle Energy Technique Versus Maitland's Mobilization Technique on Pain, ROM and Disability in Patients with Frozen Shoulder which included 58 patients allocated in two groups with 29 patients in each group receiving SPENCER MET and Conventional Physiotherapy and MM and Conventional Physiotherapy for 5days a week with total duration of 4 weeks. The study results shown was Spencer MET was effective for improving pain, reducing disability, and increasing ROM32.

Ki-suk park, Ki-yonk Jeong, et al, conducted a study to evaluate the value of Spencer technique on the Range of Motion (ROM), Pain, function in patients with Shoulder Adhesive Capsulitis with 30 patients randomly assigned into 2groups: Spencer Technique (ST) group (n=15), Self-Assistive ROM exercise(S-A ROM E) group (n=15) an intervention program was given for 30 minutes per day and was repeated 3 times a week for 4 weeks a total of 12 times. The study results showed that Spencer technique was more effective for improving ROM, pain, functional ability than self-assistive ROM exercise35.

P. Khyathi, et al, conducted an Experimental study to compare the effectiveness of Mulligan's Mobilization with Movement with that of Spencer Technique on improving pain, abduction and external rotation ROM and functional disability in subjects with frozen shoulder with 40 subjects with unilateral Frozen Shoulder were randomized into 2 groups with 20 subjects each in Mulligan and in Spencer group. The results showed that Spencer Technique is effective on improving pain, shoulder mobility and functional disability41.

Therapeutic Ultrasound (TUS), which is a deep heat modality, has been used for more than 60 years in clinics but the effects of TUS in pain, soft tissue lesions and musculoskeletal injuries remains questionable. TUS is effective in increasing the ROM of periarthritic shoulders. Collagen and tendon extensibility increases as temperature increases. As a result, Stretching should begin during heating and continue as the tissue cools and sets.

Hacer Dogru,et al, conducted a study on Effectiveness of Therapeutic Ultrasound in Adhesive capsulitis, including Forty-nine patients with adhesive capsulitis were randomized to US (n ¼ 25) and Sham US (n ¼ 24) groups. Superficial Heat and an exercise program were given to both groups. Therapeutic Ultrasound was applied to US group and imitative Ultrasound was applied to Sham US group for 2 weeks. The study results were shown that SHAM US group was more effective in improving Shoulder ROM and functions50.

When selecting a physical treatment method for Adhesive Capsulitis, it is extremely important to consider the patient's symptoms, stage of the condition, and recognition of different patterns of motion loss. There is a fair level of evidence for manual exercises for Adhesive Capsulitis.

Ola.i.ibrahim, salwa f. abdel-majid, et al, conducted a study to compare the combined effect of Shoulder Mobilization and Therapeutic Exercises on pain, range of motion, and overall shoulder functions between stage II and stage III frozen shoulder. Thirty patients referred as frozen shoulder, were divided according to their stage of illness equally into two groups; group A (stage II) and group B (stage III). Both groups were treated with Mobilization, Stretching Exercises, Active Exercise and Codman Pendulum Exercises and that was 2 times per week for successive two months. Results were shown that significant effect of Mobilization and therapeutic exercises on pain and overall shoulder functions in both groups with more significant effect in group A compared with group B (p=0.0001). Also there was significant effect on shoulder ROM of flexion and abduction in group A compared with that of group B (p=0.0001). The study concluded that the combined effect of Mobilization and Therapeutic Exercises has significant effect on pain and overall shoulder functions in stage II Frozen Shoulder than stage III and a significant effect on shoulder ROM in both stages53.

Hence this study was to compare the effectiveness of Spencer Muscle Energy Technique along with Conventional Therapy on improving shoulder functions in subjects with stage 2 in Adhesive Capsulitis. Result of this study showed that there is a statistically significance found between experimental and control groups in pre-test and post-test in SF-MPQ i.e., $p=0.008<0.05$ and $p=0.000<0.05$. There is statistically no significant difference in pre-test mean in pain in experimental and control groups ($P=0.724>0.005$), whereas there is statistically significant difference in pre-test mean in experimental and control groups ($P=0.039>0.005$)

There is statistically significant difference in post-test mean in pain and disability of experimental and control groups ($P=0.035>0.005$) and ($P=0.000>0.005$).

Based on the other studies, it can be said that Conventional Therapy is commonly used for improvement of shoulder functions in subjects with Stage 2 Adhesive Capsulitis. Compared to the previous studies, our study also increased the functions of shoulder which revealed that the Spencer Muscle Energy Technique along with Conventional Therapy had more effect on improving pain, disability and shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

LIMITATION OF THE STUDY

- The study lacked the long term treatment
- The long-term follow-up after treatment is not done

RECOMMENDATION

- Studies can be done by comparing with other treatment techniques.
- Studies should be done with longer follow up.

CONCLUSION

Spencer Muscle Energy Technique along with Conventional Therapy shows significant improvement in shoulder functions in subjects with Stage 2 Adhesive Capsulitis Conventional Therapy also shows significant improvement in shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

On overall analysis, it is observed that Spencer Muscle Energy Technique and conventional therapy had shown highly significant results in improving the shoulder functions in subjects with stage 2 Adhesive Capsulitis, but there is better improvement in subjects receiving Spencer Muscle Energy Technique along with Conventional Therapy.

SUMMARY

Adhesive Shoulder Capsulitis or Arthrofibrosis commonly known as Frozen Shoulder, depicts a pathological process in which the body forms excessive scar tissue or adhesions in the capsule around the Glenohumeral Joint, leading to stiffness, pain and dysfunction. The objective of this study is to evaluate the significant difference between Spencer Muscle Energy Technique and Conventional Therapy on improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

30 subjects who fulfilled the inclusion and exclusion criteria were selected for the study and 15 subjects were randomly assigned to each of the two groups. Interventions conducted on the subjects were explained to them and written consent taken from all the subjects with Stage 2 Adhesive Capsulitis.

All the subjects were assessed for pain and disability of shoulder by SPADI, Range Of Motion by Universal Goniometry and pain by SF-MPQ, before and after the treatment period of 6 weeks.

Group A (experimental) - Spencer Muscle Energy Technique along with Conventional Therapy

Group B (control) -Conventional Therapy.

There were significant differences in SPADI, Range Of Motion and SF-MPQ within the groups and no significant differences between the groups.

The result of this study showed that all interventions were highly significant in both the groups, but there is better improvement in Spencer Muscle Energy Technique group (experimental) than Conventional Therapy group (control) in improving shoulder functions in subjects with Stage 2 Adhesive Capsulitis.

REFERENCES

1. Patriquin DA. The evolution of osteopathic manipulative technique: the Spencer technique. J Am Osteopath Assoc. 1992;92(9):1139-46. doi: 10.7556/jaoa.1992.92.9.1134, PMID 1429074.
2. Nicholas AS, Nicholas EA. Atlas of osteopathic techniques. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 2012.
3. Neviaser RJ, Neviaser TJ. The frozen shoulder. Diagnosis and management. Clin Orthop Relat Res. 1987;22(223):59-64. doi: 10.1097/00003086-198710000-00008, PMID 3652593.
4. St Clair P. Manipulative treatment of athletic injuries to joints. Hollywood, CA: Golden West Press; 1941.
5. Spencer CH. Shoulder technique. J Am Osteopath Assoc. 1916;15:218-20.
6. DiGiovanna E, Schiowitz S. An osteopathic approach to diagnosis and treatment. Philadelphia: J B Lippincott Publishers Co; 1991. p. 281-2.
7. Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder: a long-term follow-up. J Bone Joint Surg Am. 1992;74(5):738-46. doi: 10.2106/00004623-199274050-00013, PMID 1624489.
8. Hand C, Clipsham K, Rees JL, Carr AJ. Long-term outcome of frozen shoulder. J Shoulder Elbow Surg. 2008;17(2):231-6. doi: 10.1016/j.jse.2007.05.009, PMID 17993282.
9. Binder AI, Bulgen DY, Hazleman BL, Roberts S. Frozen shoulder: a long-term prospective study. Ann Rheum Dis. 1984;43(3):361-4. doi: 10.1136/ard.43.3.361, PMID 6742896.
10. Neviaser AS, Hannafin JA. Adhesive capsulitis: a review of current treatment. Am J Sports Med. 2010;38(11):2346-56. 42. doi: 10.1177/0363546509348048, PMID 20110457.
11. Uppal HS, Evans JP, Smith C. Frozen shoulder: a systematic review of therapeutic options. World J Orthop. 2015;6(2):263-8. doi: 10.5312/wjo.v6.i2.263, PMID 25793166.
12. Manske RC, Prohaska D. Diagnosis and management of adhesive capsulitis. Curr Rev Musculoskelet Med. 2008;1(3-4):180-9. doi: 10.1007/s12178-008-9031-6, PMID 19468904.
13. Tasto JP, Elias DW. Adhesive capsulitis. Sports Med Arthrosc Rev. 2007;15(4):216-21. doi: 10.1097/JSA.0b013e3181595c22, PMID 18004221.
14. Neviaser AS, Hannafin JA. Adhesive capsulitis: a review of current treatment. Am J Sports Med. 2010;38(11):2346-56. doi: 10.1177/0363546509348048, PMID 20110457.
15. Neviaser JS. Adhesive capsulitis of the shoulder: a study of the pathological findings in periarthritis of the shoulder. J Bone Joint Surg. 1945;27:211-22.
16. Bunker TD, Anthony PP. The pathology of frozen shoulder. A Dupuytren-like disease. J Bone Joint Surg Br. 1995;77-B(5):677-83. doi: 10.1302/0301-620X.77B5.7559688.
17. Zreik NH, Malik RA, Charalambous CP. Adhesive capsulitis of the shoulder and diabetes: a meta-analysis of prevalence. Muscles Ligaments Tendons J. 2016;6(1):26-34. doi: 10.11138/mltj/2016.6.1.026, PMID 27331029.
18. Chaitow L. Muscle energy technique. 4th ed. London: Churchill Livingstone Elsevier; 2013; P.-334.
19. Boyle-Walker KL, Gabard DL, Bietsch E, Masek-VanArsdale DM, Robinson BL. A profile of patients with adhesive capsulitis. J Hand Ther. 1997;10(3):222-8. doi: 10.1016/s0894-1130(97)80025-7, PMID 9268913.
20. Ryu KN, Lee SW, Rhee YG, Lim JH. Adhesive capsulitis of the shoulder joint: usefulness of dynamic sonography. J Ultrasound Med. 1993;12(8):445-9. doi: 10.7863/jum.1993.12.8.445, PMID 8411327.
21. Mengiardi B, Pfirrmann CW, Gerber C, Hodler J, Zanetti M. Frozen shoulder: MR arthrographic findings. Radiology. 2004;233(2):486-92. doi: 10.1148/radiol.2332031219, PMID 15358849.
22. Griggs SM, Ahn A, Green A. Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment. J Bone Joint Surg Am. 2000;82(10):1398-407. doi: 10.2106/00004623-200010000-00005, PMID 11057467.
23. Rodeo SA, Hannafin JA, Tom J, Warren RF, Wickiewicz TL. Immunolocalization of cytokines and their receptors in adhesive capsulitis of the shoulder. J Orthop Res. 1997;15(3):427-36. doi: 10.1002/jor.1100150316, PMID 9246090.

24. Lubis AM, Lubis VK. Matrix metalloproteinase, tissue inhibitor of metalloproteinase and transforming growth factor-beta 1 in frozen shoulder, and their changes as response to intensive stretching and supervised neglect exercise. J Orthop Sci. 2013;18(4):519-27. doi: 10.1007/s00776-013-0387-0, PMID 23604641.
25. Bunker TD, Reilly J, Baird KS, Hamblen DL. Expression of growth factors, cytokines and matrix metalloproteinases in frozen shoulder. J Bone Joint Surg Br. 2000;82(5):768-73. doi: 10.1302/0301-620x.82b5.9888, PMID 10963182.
26. Lho YM, Ha E, Cho CH, Song KS, Min BW, Bae KC, et al. Inflammatory cytokines are overexpressed in the subacromial bursa of frozen shoulder. J Shoulder Elbow Surg. 2013;22(5):666-72. doi: 10.1016/j.jse.2012.06.014, PMID 22999851.
27. Hand GC, Athanasou NA, Matthews T, Carr AJ. The pathology of frozen shoulder. J Bone Joint Surg Br. 2007;89(7):928-32. doi: 10.1302/0301-620X.89B7.19097, PMID 17673588.
28. Kabbabe B, Ramkumar S, Richardson M. Cytogenetic analysis of the pathology of frozen shoulder. Int J Shoulder Surg. 2010;4(3):75-8. doi: 10.4103/0973-6042.76966, PMID 21472067.
29. Ling Y, Peng C, Liu C, Zhang N, Yue S. Gene polymorphism of IL-6 and MMP-3 decreases passive range of motion after rotator cuff repair. Int J Clin Exp Pathol. 2015;8(5):5709-14. PMID 26191285.
30. Kim YS, Kim JM, Lee YG, Hong OK, Kwon HS, Ji JH. Intercellular adhesion molecule-1 (ICAM-1, CD54) is increased in adhesive capsulitis. J Bone Joint Surg Am. 2013;95(4):e181-8. doi: 10.2106/JBJS.K.00525, PMID 23426775.
31. Raykha CN, Crawford JD, Burry AF, Drosdowech DS, Faber KJ, Gan BS, et al. IGF2 expression and b-catenin levels are increased in frozen shoulder syndrome. Clin Invest Med. 2014;37(4):E262-7. doi: 10.25011/cim.v37i4.21733, PMID 25090267.
32. Watson RS, Gouze E, Levings PP, Bush ML, Kay JD, Jorgensen MS, et al. Gene delivery of TGF-b1 induces arthrofibrosis and chondrometaplasia of synovium in vivo. Lab Invest. 2010;90(11):1615-27. doi: 10.1038/labinvest.2010.145, PMID 20697373.
33. Arkkila PE, Kantola IM, Viikari JS, Rönnemaa T. Shoulder capsulitis in type I and II diabetic patients: association with diabetic complications and related diseases. Ann Rheum Dis. 1996;55(12):907-14. doi: 10.1136/ard.55.12.907, PMID 9014585.
34. Prodromidis AD, Charalambous CP. Is there a genetic predisposition to frozen shoulder? A systematic review and meta-analysis. JBJS Rev. 2016;4(2). doi: 10.2106/JBJS.RVW.O.00007, pii: 01874474-201602000-00004. PMID 27490134.
35. Harris JD, Griesser MJ, Copelan A, Jones GL. Treatment of adhesive capsulitis with intra-articular hyaluronate: a systematic review. Int J Shoulder Surg. 2011;5(2):31-7. doi: 10.4103/0973-6042.83194, PMID 21897581.
36. Wu CH, Chen WS, Wang TG. Elasticity of the coracohumeral ligament in patients with adhesive capsulitis of the shoulder. Radiology. 2016;278(2):458-64. doi: 10.1148/radiol.2015150888, PMID 26323030.
37. Li JQ, Tang KL, Wang J, Li QY, Xu HT, Yang HF, et al. MRI findings for frozen shoulder evaluation: is the thickness of the coracohumeral ligament a valuable diagnostic tool? PLOS ONE. 2011;6(12):e28704. doi: 10.1371/journal.pone.0028704, PMID 22163326.
38. Rundquist PJ, Anderson DD, Guanche CA, Ludewig PM. Shoulder kinematics in subjects with frozen shoulder. Arch Phys Med Rehabil. 2003;84(10):1473-9. doi: 10.1016/s0003-9993(03)00359-9, PMID 14586914.
39. Mao CY, Jaw WC, Cheng HC. Frozen shoulder: correlation between the response to physical therapy and follow-up shoulder arthrography. Arch Phys Med Rehabil. 1997;78(8):857-9. doi: 10.1016/s0003-9993(97)90200-8, PMID 9344306.
40. Lin JJ, Wu YT, Wang SF, Chen SY. Trapezius muscle imbalance in individuals suffering from frozen shoulder syndrome. Clin Rheumatol. 2005;24(6):569-75. doi: 10.1007/s10067-005-1105-x, PMID 15902524.
41. Smith SP, Devaraj VS, Bunker TD. The association between frozen shoulder and Dupuytren's disease. J Shoulder Elbow Surg. 2001;10(2):149-51. doi: 10.1067/mse.2001.112883, PMID 11307078.
42. Saunders DG, Walker JR, Levine D. Joint mobilization. Vet Clin North Am Small Anim Pract. 2005;35(6):1287-316. doi: 10.1016/j.cvsm.2005.07.003, PMID 16260314.
43. Hannafin JA, Chiaia TA. Adhesive capsulitis: A treatment approach. Clin Orthop Relat Res. 2000;372(372):95-109. doi: 10.1097/00003086-200003000-00012, PMID 10738419.
44. Çelik D, Kaya Mutlu E. Does adding mobilization to stretching improve outcomes for people with frozen shoulder? A randomized controlled clinical trial. Clin Rehabil. 2016;30(8):786-94. doi: 10.1177/0269215515597294, PMID 26229109. -.
45. OLA I, IBRAHIM SF. ABDEL-MAJID, comparative study of the combined effect of therapeutic exercises and mobilization between Stage II and Stage III frozen shoulder Med. J Cairo Univ. 2020;88(4, September):1531-7.
46. Jivani RR, Hingarajia DN. Effect of Spencer muscle energy technique versus Maitland's mobilization technique on pain, ROM and disability in patients with frozen shoulder: A comparative study. Int J Physiother Res. 2021;9(4):3928-36. doi: 10.16965/ijpr.2021.148.
47. Jehaman I, Berampu Sabirin. Benefits of giving manual therapy and Codman pendular exercise on functional activities of Frozen shoulder patients. Jurnal Pengabdian Kepada Masyrakat e ISSN: 2775-2437 Edisi Juni 2021. Vol. 1(1).
48. Almureef SS, Ali WM, Shamsi S, Al Zahrani MB. Effectiveness of mobilization with conventional physiotherapy in frozen shoulder: A systematic review. Int J Rec Innov Med Clin Res. 2020;2(4):22-9.
49. Iqbal M, Riaz H, Ghous M, Masood K. Comparison of Spencer muscle energy technique and passive stretching in adhesive capsulitis: A single blind randomized control trial. J Pak Med Assoc. 2020;70(12(A)):2113-8. doi: 10.5455/JPMA.23971, PMID 33475581.

50. Jumbo SU, MacDermid JC, Packham TL et al. Reproducibility: reliability and agreement parameters of the revised Short McGill Pain Questionnaire. 2nd version for use in patients with musculoskeletal shoulder pain. Health Qual Life Outcomes 18. Vol. 365; 2020.
51. Ki-Suk park K-YJ. The effects of Spencer technique on the ROM, pain, function in patients with shoulder adhesive capsulitis. 2018;24(2):37-42.
52. Curcio JE, Grana MJ, England S, Banyas PM, Palmer BD, Placke AE; et al. Use of the Spencer technique on collegiate baseball players: effect on physical performance and self-report measures'. Journal of Osteopathic Medicine. 2017;117(3):166-75. doi: 10.7556/jaoa.2017.031.
53. Contractor ES, Agnihotri DS, Patel RM. Effect of Spencer Muscle Energy Technique on pain and functional disability in cases of adhesive capsulitis of shoulder joint. Int Arch Integr Med. 2016;3(8):126-31.
54. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. Shoulder Elbow. 2017;9(2):75-84. doi: 10.1177/1758573216676786, PMID 28405218.
55. Gutiérrez Espinoza HJ, Pavez F, Guajardo C, Acosta M. Glenohumeral posterior mobilization versus conventional physiotherapy for primary adhesive capsulitis: a randomized clinical trial. Medwave. 2015 September 22;15(8). English, Spanish. doi: 10.5867/medwave.2015.08.6267, PMID 26485477.
56. Uppal HS, Evans JP, Smith C. Frozen shoulder: A systematic review of therapeutic options. World J Orthop. March 18 2015;6(2):263-8. doi: 10.5312/wjo.v6.i2.263, PMID 25793166.
57. Jason JI, Sundaram S G, Subramani M V. Physiotherapy interventions for adhesive capsulitis of shoulder: a systematic review. Int J Physiother Res. 2015;3(6):1318-25. doi: 10.16965/ijpr.2015.198.
58. Antonietti L, Luna N, Nogueira G, Ito A, Santos M, Alonso A et al. Reliability Index of inter- and intra-rater of manual goniometry and computerized biophotogrammetry to assess the range of motion of internal and external shoulder rotation. Medical Express. 2014;1(2):95-9. doi: 10.5935/MedicalExpress.2014.02.08.
59. Shahbaz Nawaz Ansari et al., effect of ultrasound therapy with end range mobilization over cryotherapy with capsular stretching on pain in frozen shoulder – a comparative study. Int J Curr Res Rev. December 2012 / Vol 04.
60. Kolber MJ, Hanney WJ. the reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report. Int J Sports Phys Ther. 2012;7(3, June):306-13. PMID 22666645.
61. Breckenridge JD, McAuley JH. Shoulder pain and disability index (SPADI). J Physiother. 2011;57(3):197. doi: 10.1016/S1836-9553(11)70045-5, PMID 21843839.
62. Ewald A. Adhesive capsulitis: a review. Am Fam Phys. 2011;83(4):417-22. PMID 21322517.
63. Hacer. Dogru et al., Effectiveness of therapeutic ultrasound in adhesive capsulitis. Joint Bone Spine. 2008;75:445.e45.
64. Knebl JA, Shores JH, Gamber RG, Gray WT, Herron KM. Improving functional ability in the elderly via the Spencer technique, an osteopathic manipulative treatment: a randomized, controlled trial. J Am Osteopath Assoc. 2002;102(7):387-96. PMID 12138953.
65. Patriquin DA. The evolution of osteopathic manipulative technique: the Spencer technique. J Am Osteopath Assoc. 1992;92(9):1134-46. doi: 10.7556/jaoa.1992.92.9.1134, PMID 1429074.
66. Melzack R. The short-form McGill pain questionnaire. Pain. 1987;30(2):191-7, ISSN 0304-3959.3(12):e2029581. doi: 10.1016/0304-3959(87)91074-8, PMID 3670870.