

COMPARATIVE EFFECTS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND STATIC STRETCHING ON PAIN, RANGE OF MOTION AND FUNCTIONAL OUTCOMES IN SHOULDER IMPINGEMENT SYNDROME

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Abstract

Background: Shoulder impingement syndrome is a common condition that occurs when the tendons or bursa in the shoulder become compressed or pinched during arm movements, particularly overhead activities. The shoulder is a complex joint with several structures, including the rotator cuff tendons and the subacromial bursa, which can get irritated or inflamed due to this pinching. This can lead to pain, reduced range of motion, and weakness in the shoulder. There are very few studies comparing the effectiveness of these therapies, though.

Objective: The study was conducted to determine the comparative effects PNF and Static Stretching on pain, range of motion, and functional outcomes in shoulder impingement syndrome.

Methods: This was a randomized clinical trial study. Data was collected from Faisal Hospital, Move better and Abwa Clinics. 38 participants were selected by using non-probability, purposive sampling technique. Participants were randomly allocated into two different groups. Randomization was done by lottery method. The baseline treatment was high frequency TENS of 150 Hz for 15 minutes. Group A received Proprioceptive Neuromuscular Facilitation Technique along with baseline treatment and group B received Static stretching. PNF stretching was performed 3 sets of 5 repetitions 3-4 times per week. In Static stretching stretch every muscle group three times a week and the baseline treatment was given for 15 minutes for four weeks. Baseline treatment was same for both groups. The interventions were performed three times per week on alternate days for four weeks. Data was collected at the baseline and at fourth week.

Outcomes measurement tools: The outcome metrics that was utilized in Shoulder Impingement Syndrome methodology was Visual Analogue Scale (VAS), Goniometer for measuring range of motion and Shoulder Pain And Disability Index (SPADI).

Data Analysis: The data was analysed by using SPSS version 23.

Result: P value of between groups comparison of VAS is .001, SPADI is .000, Flexion is .000, Extension is .004, Internal rotation is .000 and External Rotation is .000.

Conclusion: Study concluded that PNF technique is more effective than Static Stretching in relieving pain, improving range of motion and functional outcomes in Shoulder Impingement Syndrome.

INTRODUCTION

The rotator cuff tendons get inflamed as they pass through the subacromial area, which is situated beneath the acromion, resulting in shoulder impingement syndrome. Those who participate in sports or other activities that require spinning movements above the head, such as body builders, are more likely to have this illness. Severe discomfort that worsens with activity and at night when sleeping on affected side is defines as shoulder impingement syndrome (SIS) (Yousfvand et al., 2023).

SIS was first discovered by Charles Neer in 1972, reported as the tightness of soft tissues under the acromion that negotiated the capability. He said that the syndrome is caused by a mechanical compression of the rotator cuff tendons when the shoulder is flexed forward and rotated inward, just below the front-lower portion of the acromion. Shoulder Impingement Syndrome is giving rise in functional limitations which considerably mess with the subject's quality of life .Shoulder pain is genrated by shoulder impingement syndrome is wide ranging and forces a significant load on the affected population (Peteraitis et al., 2020).

Shoulder impingement syndrome (SIS) does not recognize a accurate morbid context of the shoulder but comparatively a change of disorders, typically irritating, that are distinguish by agitating degenerative symptoms influenced the subacromial soft tissues. The consecuation of the pathological changes produced by the syndrome that can precede to tear of the rotator cuff. Impingement symptoms may highlight after an injury and Usually the pain starts out slowly and gets worse over several weeks or months. The middle of the outer humerus is where the pain extends from the front and side of the acromion, where it is most intense.The primary manifestation of this illness is due to structural variations that automatically confined the subacromial space. The secondary structure outcomes occur due to functional distraction at the junction of humeral head (Castaldo et al., 2023).

Shoulder impingement syndrome is important to distinguish because if unrefined it can effect in persistent pain, decline in shoulder joint conditions and, in more serious situations, rotator cuff tears.The position of impingement can be used to

show shoulder impingement, which can be either internal or external, or the primary or secondary cause.Sub-subacromial impingement, sometimes referred to as an external impingement, is caused by a real or reflexive disruption of the soft tissue within the sub-subacromial region. Internal impingement, on the other hand, results from the rotator cuff tendons being stuck in the area that separates the glenoid rim from the humeral head (Tauqeer et al., 2024).

Shoulder Impingement Syndrome does not report one particular defect but either a range of viable pathological processes. It include subacromial bursitis, calcific tendinitis, rotator cuff tears, and partial thickness tears. The primary symptoms of shoulder impingement syndrome include pain, disability, and loss of function. Combinations of exercise, steroid injections, and surgery are used as treatment choices for patients who are difficult or critical. Proprioceptive shoulder exercises, strengthen joint position acknowledge and resistance training are enhancing progressively evidencebased proposals that conclude movement-based exercise regimens (Singh et al., 2022).

Subacromial impingement syndrome accounts for 44% to 65% of reported occurrences of shoulder pain, making it the most common cause (De Witte et al., 2011). A person's standard of living is adversely affected by shoulder problems, according to a number of studies, including pain, limited Range of Motion (ROM) and decreased muscular strength. A variety of clinical disorders including localized inflammation and deterioration of rotator cuff tendon and bursa can obvious as shoulder impingement syndrome. For shoulder igement, a variety of treatment approaches are recommended such as electrotherapy, corticosteroid injections, non-steroidal anti-inflammatory medications and stabilization exercises (İğrek et al., 2022).

Scapular stabilization, Rotator Cuff Strengthening, Stretching exercises, Proprioceptive Neuromuscular Facilitation (PNF) and Range of Motion (ROM) are the components of Therapeutic Exercises that are said to be useful in redeveloping Shoulder results. Exercises for scapular stability are thought to play a significant influence in improving shoulder

discomfort and deformities. There is a lot of evidence to support shoulder reconstruction exercises. When a patient presents with subacromial impingement syndrome, kinematics is frequently suggested as a therapy option (Ravichandran et al., 2020).

Enhancing upper extremity outcomes and reducing pain are the major goals of treatment for subacromial impingement syndrome. Conventional treatment of subacromial impingement syndrome repeatedly required a variation strategy incorporate as electrotherapy, manual therapy (MT), exercise, non-inflammatory medications, and corticosteroid injections. These are beneficial exercise for subacromial impingement syndrome patients. When moving actively, people with subacromial impingement syndrome move their humeral heads extraordinary. Thus, impingement symptoms may reduce as a result of mobilization consider to bring back capsule mobility (Azin et al., 2023).

Among its various consequences, a Rotator Cuff tear is the most frequent injuries to the shoulder.

Rotator cuff tears (RCT) are a common cause of shoulder discomfort and dysfunction in adults over 50. Age is a contributing factor, however the precise cause is still unknown. Subacromial impingement syndrome is distinguished kinematic defects of the glenohumeral compound and the rotator cuff which act a part in its etiology and evaluation. Recurring overhead action is the most occurring danger for subacromial tenderness and rotator cuff tendinopathy (Sonone et al., 2023).

The scapulothoracic interphase, the subacromial area, glenohumeral, acromioclavicular and sternoclavicular joints form the shoulder. Its well defined structure and biomechanical features form it the most flexible joint in the body. The upper shoulder is difficult compound which is made up of parts of the scapula and clavical joint the upper limb to the trunk through the sternoclavicular joint and the scapulothoracic muscle. The scapula is the root of the shoulder and has numerous muscle insertions. The glenohumeral joint which is primary stabled by soft tissues. The constant stables include the labrum with its particular shape and bind to the glenohumeral capsule and ligament (Barnechea et al., 2021).

1.1 Shoulder Impingement Syndrome:

Shoulder pain is most prevailing in the population. It reports for the third most frequent musculoskeletal pain in primary care settings. Especially Shoulder Impingement Syndrome (SIS) is one of the most typical clinical presentations of shoulder ache in clinical practice. The shoulder impingement syndrome is a frequently used to report symptoms, such as pain and impairment of shoulder movements due to rupture of structures, encompassing the muscles of the Rotator Cuff and the Subacromial Bursa, which are situated in the Subacromial space. Considerably risk factors related with shoulder impingement syndrome are including aging, diabetes, work with shoulder above 90°, altered shoulder kinematics, and poor posture (Ozlu et al., 2024).

SIS involve the reduction of the subacromial space which causes decomposition of Subacromial tissues like the Rotator Cuff and bursa. General physiotherapy interventions for this impingement syndrome comprise of stretching, strengthening, and neuromuscular control of the shoulder muscles. Particularly scapular Strengthening activities have been characterized as beneficial in minimize discomfort and functional impairment within individual of subacromial impingement syndrome in many studies including that of (Ravichandran et al., 2020). Reducing scapular upward rotation during shoulder elevation can decrease the subacromial space, disrupt tissue healing and impart to an exacerbate in symptomatic impingement (Afzalifard et al., 2023)

The glenohumeral joint is a ball-and-socket joint in anatomy and a diarthrodial, multi-axial joint in function. Connecting the humeral head to the glenoid cavity of the scapula, the glenohumeral articulation is the primary joint of the shoulder girdle. Insignificant roles in shoulder movement are also played by the Sternoclavicular, Scapulothoracic and Acromioclavicular joints. The human body's most mobile joint is the glenohumeral joint. Maximum degrees of motion in several body planes are made feasible by the constant and active stable structures which place the joint at chance of instability occurrences (Chang et al., 2023).

A shoulder joint is unable to move fully and generally along with pain and soreness are common



signs of impingement syndrome. An injury often begins a chain reaction that incorporates raise pain, edema, pressure on the tendons and bursa. When you elevate your arm over your head or extend it away from your body, you may experience pain or weakness (Creech et al., 2020).

The "functional" version of SIS is caused by muscular imbalance, Rotator Cuff pathology or Glenohumeral fragility which leads humeral head upward and constriction of the Subacromial region. For e.g, innate defects in the Rotator Cuff tendon cause the humerus migrate to superiorly because the deltoid force is exerted against a reduced (downward) antagonizing force. Broad range of Shoulder disorders, including Subacromial bursitis, Biceps tendinitis and Rotator Cuff tendinitis are included in SIS (Bolia et al., 2021).

1.2 Proprioceptive Neuromuscular Facilitation

Proprioceptive Neuromuscular Facilitation (PNF) is a Stretching technique that increases muscle strength, Range of Motion (ROM), and function by employing certain movement patterns and resistance. Numerous movements, including diagonal movement patterns, rhythmic stabilization, and repeated contractions, are necessary for the PNF procedures. These motions are practiced using resistance provided by the apparatus or the therapist. One type of PNF that is commonly used to treat muscular stiffness, tightness, and restricted range of motion is the hold-relax technique. The method entails actively tightening a muscle for a number of seconds, relaxing for a short while, and then passively stretching the muscle (Rahman et al., 2024).

Proprioceptive neuromuscular facilitation technique is effective for decreasing pain and assist to execute functional tasks certainly. The best viable capacity for muscles to act is given by Proprioceptive neuromuscular facilitation techniques, in particular, the agonist and antagonist's reciprocal activation to the potential range (Altaf et al., 2024).

1.3 Static Stretching

Static Stretching is a technique that takes muscle to maximum range of motion and retains the muscle in that position for a fixed period of time. Even if stretching exercises are an main part of rehabilitation

programs and sport exercises, few studies have examined the immediate effect of many types of muscle stretching on PNF and current studies have reported opposite results. In static stretching, the subject's arm was passively moved to limit the Range of Motion by the examiner and held for 30 seconds (Türksan et al., 2024)

Static stretching is a steady, continuous hold out in which limit the Range of Motion is maintained for predetermined time, such as 30 seconds. Even while static stretching has been demonstrated to have a negative impact on performance, despite its many benefits, it is typically stopped shortly before engaging in activities requiring maximum strength or power (Behm et al., 2011). Both neurological and mechanical processes have been implicated in the decline in strength and power that occurs after an acute period of static stretching (Young et al., 2010). Static stretching may reduce the number of motor units available for contracting muscles, which may have a detrimental effect on brain activation (Tauqeer et al., 2024)

SS is a safe and easy stretching method that can be used either passively or vigorously. The muscle is stretched either passively or aggressively during this process close to ROM in a commanding manner, or until the subject experiences a stretch or tolerable pain, and they remain in this position for a certain amount of time. Its main mechanisms include decreased stiffness of the muscle-tendon unit (MTU), greater stretch tolerance, and decreased reflex activity. On the other hand, repeated and continuous SS has been linked to a decline in muscle and athletic performance, including response time, balance, agility, strength, and jump height. It can be explained by neurological and mechanical causes. By lengthening and increasing compliance of the MTU mechanically, SS lowers peak torque and the speed at which muscles contract. From a neurological perspective, SS may lessen nerve signals and optimal muscular contraction (Ceballos-Laita et al., 2024)

1.4 Rationale of Study

The rationale of this study there was limited literature on Proprioceptive neuromuscular facilitation and static stretching techniques in individuals of the shoulder impingement syndrome. Direct comparison between these two methods had

not yet been documented in individual of shoulder impingement syndrome. The objective of study were to determine the comparative effects of Proprioceptive neuromuscular facilitation and static stretching techniques on range of motion, pain and functional outcomes within individuals of SIS.

1.5 Research Question

What is the effect of Proprioceptive Neuromuscular Facilitation and Static Stretching exercise on Pain, ROM and function impairment in shoulder impingement individuals?

1.6 Objectives

The aim of study were to compare analysis the effects of PNF and Static stretching on Pain, ROM, functional outcomes in shoulder impingement syndrome. To determine effects of Proprioceptive Neuromuscular Facilitation (PNF) and Static Stretching on pain, Range of Motion and functional outcomes in SIS.

1.7 HYPOTHESIS

1.7.1. Null Hypothesis

There is no significant difference in PNF and static stretching on pain, ROM, functional outcomes in shoulder impingement syndrome.

1.7.2. Alternative Hypothesis

There is significant difference in PNF and static stretching pain, ROM, functional outcomes in shoulder impingement syndrome.

LITERATURE REVIEW

A randomized control trial design was carried out research on stroke patients suffering from scapular dyskinesia and asymmetry. 46 sufferers of type-1 scapular dyskinesia, ages 40 to 60, who had suffered a stroke at least five months earlier were involved in this investigation. The participants were split into 2 groups and assigned upper limb flexion patterns, known as Diagonal 1 (D1) and Diagonal 2 (D2), by a lottery-style successive sampling procedure. We measured shoulder Range of Motion using Goniometry, Shoulder disability applying Shoulder Pain And Disability Index (SPADI) and scapular asymmetry using lateral scapular sliding test. D1 and D2 flexion improved range of motion (ROM) and

reduced discomfort and disability in both groups. Between-group comparisons, however, did not show a statistically significant difference in the two therapies' respective efficacies about pain as assessed by Visual Analogue Scale (VAS) and Range of Motion (ROM) (Rahman et al., 2024).

A cross-sectional research was carried out on hand grip strength and dynamic stability among athletes who perform overhead with and without scapular dyskinesia. Twenty professional overhead athletes who were asymptomatic and had scapular dyskinesia and another twenty who did not were discovered by means of the test for lateral scapular sliding. This investigation is cross-sectional employed an isokinetic dynamometer to measure shoulder proprioception also known as active joint position perception. A hand-held dynamometer and Upper quarter alter star excursion balancing test were used to measure upper extremity dynamic balance and handgrip Strength. The study found that compared to the group without the disease, those with scapular dyskinesia exhibited significantly reduced shoulder active joint position sensation. The findings showed that in asymptomatic overhead athletes, scapular dyskinesia may have an impact on the perception of shoulder active joint position. But it had no impact on the stability of their upper extremity dynamics or hand grip strength (Reyhani et al., 2024).

A single blinded randomized control trial research was conducted. In this study, thirty-two people in all were considered in study, sixteen of them were allocated to each group. The mean age of the treatment group was 38.19 ± 7.31 , compared to 35.69 ± 7.98 for the comparison group. After the intervention in the treatment group, an independent sample t-test with a 95% confidence interval was performed on the data, and statistically significant results were achieved. Functional ability and scapular protraction had considerably increased in both groups, however In the control group, neither pain nor scapular upward rotation were found to be statistically significant. When combined with exercise treatment, manual therapy produced clinically and statistically significant improvements in scapular range of motion, discomfort, and functional capacity (Tauqee et al., 2024)

A randomized control trial study was conducted on subacromial pain syndrome. In this study, There



were eight RCTs totaling 387 participants. The meta-analysis's findings showed that, in terms of Visual Analog Scale score, the experimental group (SSE) improved more than the control group (traditional physical treatment). However, there were nothing discernible variation in range of motion (ROM) between the experimental and control groups. Larger, better-quality, standardized protocols should be the main focus of future research in order to fully comprehend the impact of SSE on a variety of SAPS populations, treatments, and outcome metrics (Zhong et al., 2024)

A randomized control trial study was carried out on Subacromial ache condition. Subacromial pain syndrome patient enrolled within the Pragmatic Parallel Double blind RCT. A convenient sampling method that is non-probabilistic was employed to choose the sample. Forty patients out of the fiftysix who met the ability conditions were divided symmertically into 2 groups using a randomization web tool: the MET group (n = 20) and the MWM group (n = 20) Data were gathered both before and after the successful conclusion of an experimental six-week course of treatment. A NPRS was used to gauge the level of discomfort, the Shoulder Pain and Disability Index (SPADI) was used to gauge Shoulder discomfort, and goniometry was used to gauge ranges of motion. Both MET and MWM were valuable within alleviating symptoms of Subacromial Impingement Syndrome in this sample of 40 patients (Ishaq et al., 2024).

A study was carried out on the syndrome of subacromial impingement. The purpose of this study was to determine the impact of strengthening and stretching activities on the pain and functional impairment related to subacromial pain syndrome. The methodology used is a literature review written in the narrative style. The data for the selected publishing papers are from RCTs conducted in English between 2013 and 2022. To find published works that fit the inclusion and exclusion criteria, use PEDro and Google Scholar. Data analysis techniques include data synthesis, a synopsis of the PICO method's literature review, and an assessment of journal quality using the PEDro scale. Short-term pain reduction (VAS) and a significant improvement in function were observed with rotator cuff, scapular,

and posterior shoulder strengthening and stretching activities (Wahyuni et al., 2024).

A randomized control trial design research on a patient with functional impairment and pain from subacromial impingement syndrome was conducted. In this trial, a 6week exercise program was administered twice a week to the two randomly allocated groups of 36 patients. In the two scapula diagonals, the PNF group likewise undergoes repeated stretch PNF operations and a rhythmic start. The main results were pain and function. Secondary outcomes were depressed status, anxiety, active range of motion (ROM), scapular dyskinesis active Myofascial Trigger Points (MTrPs) and pain pressure threshold. The PNF group showed significantly better improvement in function, PPT, internal rotation ROM, active MTrPs, and satisfaction of patient as compared to the exercise group. Capsular dyskinesis only improved in the PNF group. Significant improvements were seen in two groups' levels of pain, function, ROM, PPT, active MTrPs, anxiety, and depression. Both a traditional workout program and scapular PNF treatments are part of the treatment for SIS (Akgüller et al., 2023).

A study was carried out to examine the results of scapular mobilization in patients with SIS. Seventy-two individuals with SIS were allocated at random into two groups. The control group (n = 36) and the intervention group (n = 36) both experience a 6-week exercise regimen and additionally received passive manual scapular mobilization. Both groups had evaluations done at the start and end of the treatment. The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire was used as the primary end measure to assess upper limb function. Secondary end measures included the Constant-Murley questionnaire, pain (visual analog scale (VAS) and scapular upward rotation. When scapular mobilization was introduced, there were no immediate improvements in function, discomfort, or scapular motion in SIS patients (GutiérrezEspinoza et al., 2023).

A Pre-Test-Post-Test design study was carried out on SIS. Remedial activities were applied in this study to randomly assign ten male bodybuilders with shoulder impingement syndrome to experimental group (n = 10) and control group (n = 10). To gauge the level of pain, a Visual Analog Scale (VAS)



questionnaire was employed. Functional impairment was measured using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. The Kinovea program were obtain kinematic parameters. The evaluation process were implement in 3 stages: PreTest, first Post-Test (each after eight weeks), and other post-test (each after twelve weeks duration).The functional impairment and severity of the experimental group's pain were shown to have significantly changed after eight weeks of corrective exercise. Furthermore, there were visible variations between the two groups in the shoulder's biomechanical properties during flexion, abduction, external, and internal rotations (Yousfvand et al., 2023).

A Randomized Controlled Study was carried out on patient suffering from Subacromial Impingement Syndrome. Patients in this trial were randomized to one of two groups: Exercise training (n = 24) or exercise training plus Neuromuscular Electrical Stimulation (n = 24). Questionnaire of Disabilities of the Arm, Shoulder, and Hand were used to identify shoulder function; a goniometer was used to measure range of motion; a hand held dynamo meter were applied to measure muscle Strength; and a Visual Analog Scale were applied to investigate pain (week 8). Both groups experienced improvements in Range of Motion, muscle Strength (except Flexion muscle strength in the exercise training group) and shoulder function as well as a decrease in discomfort. The addition of Neuromuscular Electrical Stimulation treatment to exercise training did not result in the primary objective, which was an improvement in shoulder function. This improvement was achieved just with exercise training (Karaaslan et al., 2023).

An interventional investigation was carried out on scapular dyskinesis. 36 people in this study satisfied the selection criteria, one of which was the application of practical sampling. Both before and after the intervention, the subjects' scapular dyskinesis was evaluated using the NPRS, manual muscle testing, and the lateral scapular sliding test. The individuals experience PNF-Rhythmic stabilization three days a week for total of 4 weeks. The group engaged in statistical analysis using the Wilcoxon test. LSST, NPRS, and MMT of the group's serratus anterior and trapezius muscles are all

highly influenced by rhythmic stability. Its final analysis shows that it is clinically significant (Pawar et al., 2023).

A randomized control design study was conducted on SIS. In third study, 2 groups of 30 people were randomly allocated: Group B was received Scapular mobilization plus Conventional physiotherapy, and Group A received Scapular PNF + conventional physiotherapy. In 2 weeks duration, the intervention was applied 6 days a week. Both groups' Pre and Post-intervention scores on Shoulder Range of Motion, Shoulder Pain and Disability Index, and Numerical Pain Rating Scale were obtained. In individuals with adhesive capsulitis, scapular mobilization in addition to traditional physiotherapy was found to be more beneficial within lowering discomfort, enhancing ROM, and enhancing function (Bhavika et al., 2023). An investigation was carried out on the role of the scapulo-thoracic complex, particularly as it relates to scapular kinematics. The Cochrane Library, PEDro, and PubMed scientific search engines were used to perform this systematic review, which only added Randomized Controlled Clinical Trials. They selected thirteen randomized clinical studies. Manual therapy for people with Subacromial Impingement, therapeutic exercise programs targeted at the scapulothoracic complex in people with subacromial impingement syndrome, and therapeutic exercise programs targeted at the scapulothoracic complex in people with shoulder pain are the three main types of interventions that can be distinguished. When compared to the control group, thoracic thrusts did not considerably improve the outcomes for patients with impingement shoulder pain (McCracken et al. 2023).

A randomized control design study was carried out on the patient of Rotator cuff syndrome. This study aims to investigate the effects of Maitland and Mulligan Mobilization on stiffness, impairment, and range of motion in individuals with RC syndrome in a Randomized Clinical Trial. Eighty participant will be split symmetrically into 2 groups, with each group receiving five therapy sessions each week for a period of six weeks. After six weeks, the results of the therapy will be assessed for a follow-up. If the expaction of our study is shown to be significant, mobilization can lead to enhanced range of motion, decreased pain, and reduced functional impairment.



Patients with rotator cuff syndrome may benefit from this treatment. We be prepared for that there would be a noticeable impact of Maitland and Mulligan mobilization on pain and disability in rotator cuff syndrome patients (Sonone et al., 2023).

A semi experimental design was conducted on shoulder impingement syndrome. In this study, using corrective exercises, ten male bodybuilders with shoulder impingement syndrome were randomly assigned to the experimental group (n = 10) and the control group (n = 10). To measure pain intensity, a Visual Analog Scale (VAS) questionnaire was employed. For functional disability, Questionnaire of Disabilities of the Arm, Shoulder, and Hand (DASH) was utilized. Kinematic parameters were obtained using the Kinovea program. Three stages of evaluations were conducted: the Pre-test, the first Post-test (each after eight weeks), and the second Post-test (each after twelve weeks). The results demonstrated that the experimental group's functional impairment and pain severity had significantly changed (Yousfvand et al., 2023).

A randomized control design study was carried out on the patient of scapular dyskinesia. 26 patients were chosen from the Aziz Fatimah Hospital in Faisalabad and the DHQ. Two groups of patients were randomly assigned. Group B received a traditional therapy group, whereas Group A received scapular Proprioceptive neuromuscular facilitation. To assess scapular dyskinesia, the lateral scapular slide test was employed. The Visual Analogue Scale, Disability Index, and Shoulder Pain were employed as outcome measures. Three sessions a week were offered for the duration of the treatment. Data were gathered at baseline and four weeks after treatment. Improvement was noted for pain and shoulder impairment in both groups according to the withingroup analysis (Altaf et al., 2023).

A cross-sectional study was carried out on SAIS patients. The objectives of cross-sectional study were assess shoulder proprioception, investigate its relationship to functional impairment and pain threshold, and deepen our knowledge of clinical consequences of Proprioceptive abnormalities within SAIS patients. 42 partiipants between the ages of 20 and 50 were found to have subacromial impingement syndrome, which is defined by Pain in one shoulder that is unilateral, without significant

hypomobility, and that gets worse near the end of range of motion (ROM) and during extended durations of abduction. Furthermore, these patients simultaneously showed positive results on the Hawkins-Kennedy test and the Neer sign. 42 people with no shoulder ache whos had not any shoulder treatment in the preceding twelve weeks made up the control group (Alfaya et al., 2023).

A randomized control trial study was carried out on subacromial impingement syndrome. Three groups of 44 patients were allocated at random to receive conventional Physical Therapy (control group), PNF exercises along to conventional physical therapy (15 PNF group), and SM procedures apart to conventional physical therapy (15 SM group). The VAS (Visual Analog Scale), Push Pull dynamo meter, Goniometer, and DASH (Disabilities of the Arm, Shoulder, and Hand) score were used to investigate Pain, Range of Motion, Muscular Strength and functionality. The patients were given treatment for four weeks, or twenty sessions. Assessments were performed in weeks two, four, and sixteen in addition to the baseline. All groups showed statistically significant increases in outcome measures following therapy. Pain and functionality were not improved more by PNF or SM groups than by any other group (İğrek et al., 2022).

A Quasi Experimental design study was conducted on patient of scapular dyskinesia associate with adhesive capsulitis. In this study, Thirty-four patients with adhesive capsulitis and scapular dyskinesia participated in a quasi-experimental study. The PNF and myofascial release method groups were assigned to the subjects. In six weeks, each received 12 sessions of treatment. Using the Numeric Pain Rating Scale and SPADI scale, the therapy's effects was assess at baseline, 2 weeks duration, 4 weeks duration, and 6 weeks duration. The study found that both the PNF and myofascial release techniques significantly improved the NPRS and SPADI score. However, the PNF technique demonstrated greater improvement in pain and function in scapular dyskinesia related to adhesive capsulitis than the myofascial release technique (Saeed et al., 2022).

A study was conducted on scapular stabiliztion. The aim of this research was to examine how patients with asymptomatic scapular dyskinesia responded to a six-week PNF application in terms of scapular



muscle strength, scapular asymmetry, and pectoralis minor muscle tension. To find out the scapular dyskinesis, 25 asymptomatic patients were evaluated using the video analysis method. 11 of them were found to have scapular dyskinesis and were selected for the PNF application. Assessment tools included the lateral scapular sliding test (LSST), tightness of PM, Upper and Lower trapezius of the Serratus anterior. Repeating contraction approach, for a period of six weeks, the PNF patterns of front elevation-posterior depression and posterior elevation-anterior depression were used twice a week. The equilibrium of the scapular muscles improved following scapular PNF exercise (Ciğercioğlu et al., 2022).

A research was use to evaluate the efficiency of manual therapy with electrotherapy for SIS. Two groups consisting of forty male athletes with SIS who were overhead were randomly assigned: ET with MT (n = 40) and ET (n = 40). Measurements of muscle activity, muscle onset delay timings, and SPADI-H score were among the evaluations. Evaluations were conducted on both groups at the beginning, middle, and end of the eight-week intervention. The ET plus MT groups increasing muscle activity, lowering SPADI score, and optimizing latency timings ($p < 0.05$). After therapy, both groups' muscle activity and SPADI-H increased ($p < 0.05$). ET with MT raised muscle activity, muscle onset latency time, and SPADI score more successfully than ET alone (Sharma et al., 2021).

An study was conducted on shoulder impingement syndrome. In this study, Three groups, comprising 25 each of SFTF, SFT, and control, were randomly assigned to 75 SIS patients, 25 of whom were male and 25 of whom were female. The first outcome was the measurement of discomfort using Visual Analog Scale (VAS). The DASH Questionnaire and a 3-D motion capture were used to measure secondary outcomes of function and scapular kinematics, respectively. Every result was assessed both before and after the eight-week interventions. According to the study's findings, patients with SIS can effectively reduce their discomfort and enhance their function and scapular kinematics by integrating a rehabilitation program with verbal assessment. Clinically improving exercise therapy outcomes for

people with SIS may be possible with the addition of assessment (Moslehi et al., 2021).

A randomized control trial study was conducted on shoulder impingement symptoms. In the study, A total 59 participant were allocated at random to either the Experimental Intervention Group (EIG, n = 31) or the Control Intervention Group (CIG, n = 28) in this prospectively registered randomized controlled study. The presence of PCT was assessed using the low flexion (LF) test. Pre and post treatment measurements were made of the following: shoulder kinematics, PPT, ER strength, internal rotation (IR) and ROM, and SPADI scores. For four weeks, participants in the EIG received a pain and PCT-specific intervention, whereas an unspecific intervention was given to individuals in the CIG. The LF test changes indicated that the experimental intervention improved PCT more successfully. For the remaining variables, there was no clear difference between the non-specific intervention and the specialized strategy (Rosa, et al., 2021).

A single experimental design study was conducted on scapular dyskinesia. In this study, if participants were blind to the treatment, 30 housekeeping employees, and ages 18 to 40, with scapular dyskinesia and neck, shoulder, or both, were randomized to either Group 1 (PNF) or Group 2 (CKC). Both groups engaged in the intervention 5 days a week for a duration of four weeks. On the intragroup analysis, every outcome measure revealed a notable improvement. The results of the intergroup comparison showed that there was no statistically significant difference between the two groups' NPRS ratings for activity and rest. Additionally, group A's ENMQ ratings improved more than group B's, which underwent CKC exercises. Group A's participants received PNF (DESAI et al., 2021).

A randomized control study was carried out on subacromial pain syndrome. In which, Exercises for scapular stabilization (SSG) or strengthening (PSG) were randomly assigned to sixty patients with SAPS. For a duration of eight weeks, the interventions were conducted three times a week. At the beginning of the intervention, four weeks, eight weeks, and sixteen weeks after baseline, the function of the primary endpoint and the secondary outcomes were assessed. Brazilian version of the Shoulder Pain and Disability Index (SPADI-Br) were used within



shoulder ache investigation. There were never any group differences in the main or secondary results (Hotta et al., 2020).

A randomized control trial design study was carried out to investigate the outcomes of Mobilization and the Hold-Relax (HR) strategy on the function of patients healing from adhesive capsulitis of the shoulder. In this study, Three groups were randomly assigned to 45 postoperative patients with adhesive capsulitis in the shoulder: 15 patients received mobilizations with movement and HR technique, 15 patients were assigned to the MWM group, and 15 patients were assigned to the control group. Each participant received three different interventions: basic physical therapy and intervention without either MWM or HR stretching, MWM on the shoulder combined with HR method in PNF stretching, and MWM on the shoulder. Each patient was randomly evaluated both before and after the intervention using the Korean version of the Shoulder Pain and Disability Index (SPADI), the Visual Analogue Scale (VAS), shoulder flexion range of motion (ROM), and shoulder flexor muscle strength. These findings suggest that using MWM and HR method in combination, rather than only MWM or MWM alone, may have a greater positive impact on shoulder function (Jung et al., 2020).

A study was carried out on Proprioceptive Neuromuscular Facilitation during scapula motor control training in chronic subacromial impingement syndrome. A 47-year-old man who had played professional handball was diagnosed with a SIS due to degeneration of the supraspinatus tendon, scapular dyskinesia, and rotator cuff tendinopathy. The patient complained of soreness in the right side of his shoulder when reaching behind his back and performing overhead tasks. Five weeks of PNF-based motor-control instruction were given. This approach blended specific PNF method exercises with specific PNF-facilitation ideas and techniques. The results demonstrated enhancement above and below the minimally detectable change or minimally clinically meaningful difference in shoulder discomfort, range of motion, functional impairment, and physical functioning (Peteraitis et al., 2020).

A randomized control trial study was conducted on SAIS. A total of thirty patients suffering from SAIS were included, they were randomly assigned to three groups: ten patients for joint mobilization, ten patients for exercise, and ten patients for combination. Following four weeks of therapy, the following outcomes were assessed: Shoulder Pain And Disability Index (SPADI); the Goniometer's Flexion, Lateral Rotation, Medial rotation and Abduction; the tone and stiffness of the Pectoralis Major (PM) and Upper Trapezius (UT) muscles; and manual inclinometer's measurement of the thoracic kyphosis. Every variable showed substantial improvements in all three groups ($p < 0.05$). In contrast mobilization and exercise groups, combination group, there was a significant improvement in thoracic kyphosis, UT muscle tone, flexion, medial rotation, and lateral rotation ROM, as well as SPADI (Park et al., 2020).

Comprehensive comparison between PNF and static Stretching in shoulder impingement syndrome are lacking in existing research. There are not many studies that make direct comparison to these interventions. The discrepancy makes it challenging for physicians. In order to enhance patient outcomes, evidence-based decision making may result in a less than ideal treatment plan. Therefore, further rehabilitation research into this gap is crucial.

MATERIAL AND METHODOLOGY

3.1 Study Design

This study was a Randomized Clinical Trial study.

3.2 Setting

Data was conducted from

- Abwa Clinic
- Move Better
- Faisal hospital

3.3 Sample Size

The sample size of 32 is calculated using epitool, with 80% power, a 0.05 margin of error, and a 95% confidence range for variable Balance (Atıcı, Aydın, Gülşen, & Surenkok). Although 35 individuals will be recruited, assuming a 10% attrition rate.

Sample Size For Comparing Two Means

Input Data			
Confidence Interval (2-sided)	95%		
Power	80%		
Ratio of sample size (Group 2/Group 1)	1		
	Group 1	Group 2	Difference*
Mean	68.43	54.08	14.35
Standard deviation	15.2	13.15	
Variance	231.04	172.923	
Sample size of Group 1	16		
Sample size of Group 2	16		
Total sample size	32		

3.4 Sampling Technique

Non-probability convenience sampling.

3.4 Duration of Study

This study was conducted in four months after approval by the ethical committee of Faisal Institute of Health Sciences, Faisalabad.

3.5: Selection Criteria

3.5.1: Inclusion Criteria: (Çelik et al., 2022)

- Both Male and female
- Age ranges from of 18 to 75 years.
- Positive impingement tests (Neer test, Hawkins-Kennedy test)

- Patients reporting pain levels of atleast 4 out of 10 on the Visual Analogue Scale for pain
- Pain that arises or intensifies when the afflicted shoulder is flexed/both internal and external Rotation .

3.5.2: Exclusion criteria (Çelik et al., 2022)

- History of clavicle, scapula or humerus fracture.
- History of any systemic illness.
- Any bone disease, congenital anomalies or active joint infection.
- Malignancies in the shoulder region.
- Non-cooperative participants

3.6 Study Groups

Baseline Treatment	Both groups received TENS electrodes at the start of each treatment session. The conventional TENS was use for 15minutes with the frequency of 150Hz set on the shoulder area. Used parameters like high frequency of 150 Hz, pulse duration of 200ms, and flow adjusted to the patient's feelings to stimulate the area of the shoulder muscles. Under the electrodes, the patient should experience some kind of vibration or tingling. (Jäschke et al., 2021)
Group A	Participants were engage in PNF stretching of 3 sets of 5 repetitions 3-4 times per week. Total duration was 4 weeks. Exercise was performing at a moderate intensity focusing on pain, ROM and functional outcomes with causing fatigue. The protocol was of include a 10-second passive stretch followed by 10seconds isometric contractions at maximal effort and then a 20-seconds assisted stretch held at the new range of motion. PNF stretching focusing on the muscles associated with shoulder impingement syndrome including the Subscapularis, Teres minor, Infraspinatus, and Supraspinatus muscles. PNF Stretching involves a combination of passive stretching and isometric contraction to improve flexibility and ROM (Cigercioglu et al., 2022).
Group B	Stretch every muscle group three times a week, or on a daily basis. There will be a total of four weeks. Muscle must be stretched farther than it usually is. Stretch for 10-30 seconds, then release it for 10 seconds. Repeat 3-4 times. Static stretching focusing on the muscles associated with shoulder impingement syndrome including the Subscapularis, Teres minor, Infraspinatus, and Supraspinatus muscles (Türksan et al., 2023).



Figure 1 TENS

3.7: Data collection Tools

3.7.1 Visual Analogue Scale:

The Visual Analog Scale (VAS) is a widely used instrument to gauge subjective sensations or experiences that are difficult to measure, including the severity of pain. It is typically represented by a horizontal line where one end denotes "no pain" and the other "worst pain imaginable." A point on the

line representing the patient's present level of pain is marked. To offer a numerical value that corresponds to the intensity of the pain, the distance from the "no pain" end is measured. This approach is frequently used in therapeutic settings to assess ailments like pain, mood, and discomfort (Gandbhir et al., 2020).

3.7.2 Shoulder Pain and Disability Index:

The SPADI was created to evaluate degree of shoulder ache and discomfort while completing daily activities by patients alone, with no professional involvement. A group of rheumatologists and physical therapists devised the initial version, which was published in 1991. Because of this history, SPADI continues to be chosen in the fields of rheumatology and rehabilitative medicine. It comprises 13 components, including 5 for pain and 8 for disability (Boake et al., 2021).

3.7.3 GONIOMETER

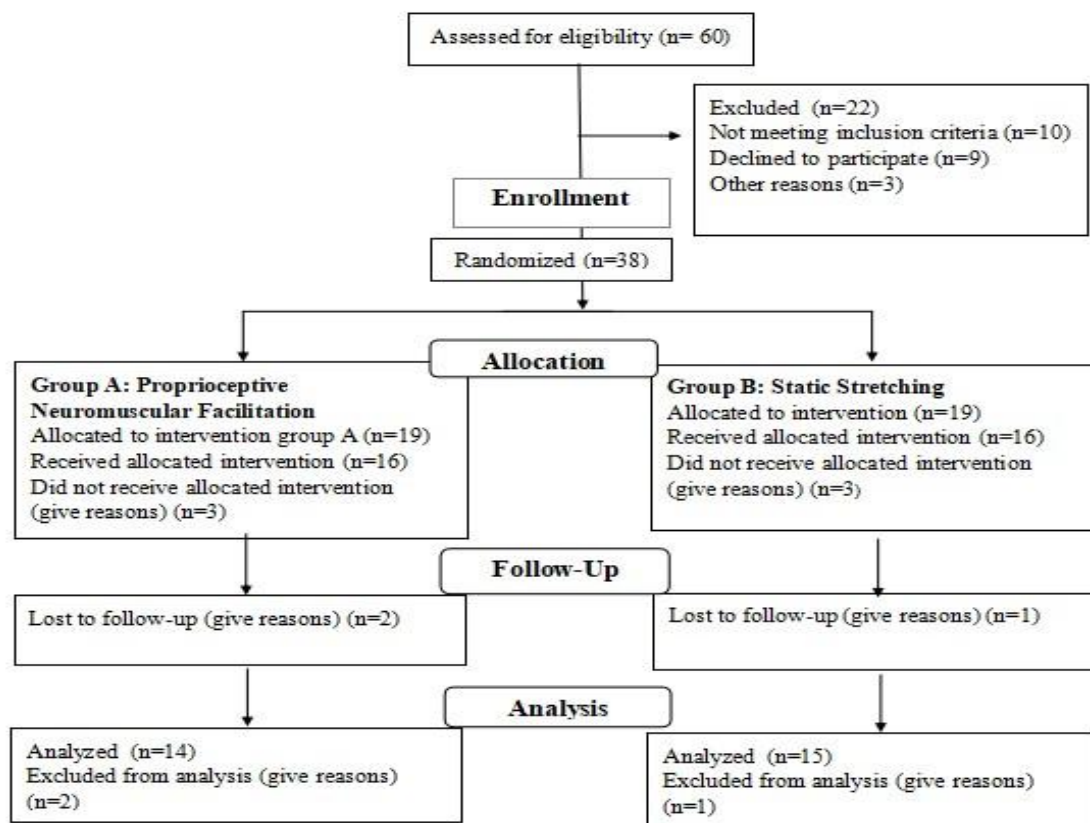
One instrument for determining the range of motion at a joint is a goniometer. Goniometry is the study of measuring joint ranges in different planes. A goniometer is commonly used by physical therapists to measure range of motion. The therapist can use the goniometer to measure the patient's current range of motion during the initial examination if they have limited range in a particular joint. They

can then assess the intervention's efficacy using it at follow-up meetings (Gandbhir et al., 2020).

3.8 Data Collection Procedure

It was a randomize clinical trial. Data is collected from different clinics, Health 360, Abwa clinic, move better. Informed consent was signed from each participant. Based on the inclusion and exclusion criteria subject was screened. 35 participants was chosen through purposive, nonprobability sampling technique. Randomization was done by lottery approach. PNF was applied to Group A and Static stretching was applied to Group B. The readings were taken at baseline and 4th week. The outcome metrics that was utilized in shoulder impingement syndrome are VAS, SPADI and Goniometer for flexion, extension, abduction, Adduction, external rotation and internal rotation. There was cross-checking of these questionnaires to ensure that the details are correctly filled out.

CONSORT DIAGRAM



3.9 Data Analysis Procedure

Data analysis for the Randomized clinical trial on the effects of PNF and Static Stretching on pain, ROM and functional outcome in shoulder impingement syndrome was conducted using SPSS version 25. The analysis was involving several steps as outlined below:

- **Descriptive Statistics:**

Descriptive statistics, including frequency, percentage, mean, and standard deviation, were calculated to summarize categorical and demographic features of the participants.

- **Normality Testing:**

The Shapiro-Wilk test was used to assess the normality of the data distribution. A significance level of $p < 0.05$ was used to determine whether the data follows a parametric or non-parametric distribution.

- **Within-Group Analysis:**

To assess changes in Pain, ROM and functional outcomes and pre- and post-intervention, the parametric or non-parametric Test were utilized. The test was determine whether there are statistically significant variations within the group before and after the PNF and Static Stretching.

- **Significance Level:**

The level of significance was set at $p < 0.05$. Statistical significance was interpreted based on the obtained p-values, with values less than 0.05 indicating a significant difference or association.

- **Interpretation of Results:**

Results from the data analysis was interpreted in the context of the study objectives and hypotheses. Changes in Pain, ROM and Functional Outcomes was evaluated to determine the effectiveness of the PNF and Static Stretching interventions in improving these outcomes.

3.10 Ethical considerations:

By keeping the data confidential, the patient's privacy was prioritized, and the ethical considerations was keep in mind. All of the patients was freely take part in this research project. The obtained data was retain on laptops and password protected. The analyzed data was exclusively use for the benefit of the patient that target population. By keeping these ethical considerations in mind, we can guarantee that our investigation was carried out in an accountable and legal manner, and that the participants' rights and welfare were secured.

GAINT CHART:

Activity	Months			
	01	02	03	04
Data Collection				
Data Analysis and Interpretation				
Thesis Presentation and Submission				

RESULTS:

Table 1 Mean and SD of the Age

Descriptive Statistics				
Age of patient	N	Mean $\pm$ Std Deviation	Minimum	Maximum
	32	45.56 $\pm$ 8.25	28	60

Table 4.1 shows descriptive statistics of age of patient. The Mean $\pm$ SD was (45.56 $\pm$ 8.25) , minimum age of participant was 28 and maximum value of age was 60.

Bar Chart of the frequency distribution o age shown below.

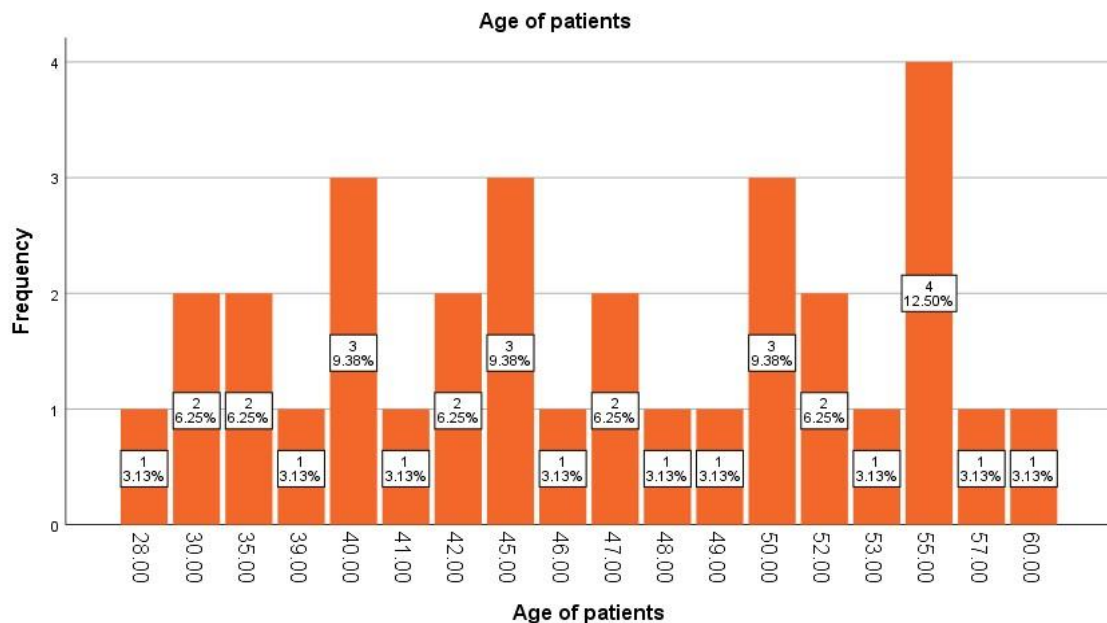


Figure 4 show frequency distribution of patient's age

Figure 4.1 show frequency distribution of gender of patient in which N= 32 and shown distribution (3.13%) at age of 28 to (12.50%) at the age of 55 was participating in this trial.

Table 2 Distribution of Gender Frequency

Gender of Patient					
		Freq.	Percent(%)	Valid %	Cummulative %
Valid	Male	18	56.3	56.3	56.3
	Female	14	43.8	43.8	100.0
	Total	32	100.0	100.0	

Table 4.2 show frequency distribution of gender of patient in which N= 32 and shown distribution (43.8%) female and (56.3%) male was participating in this trial.

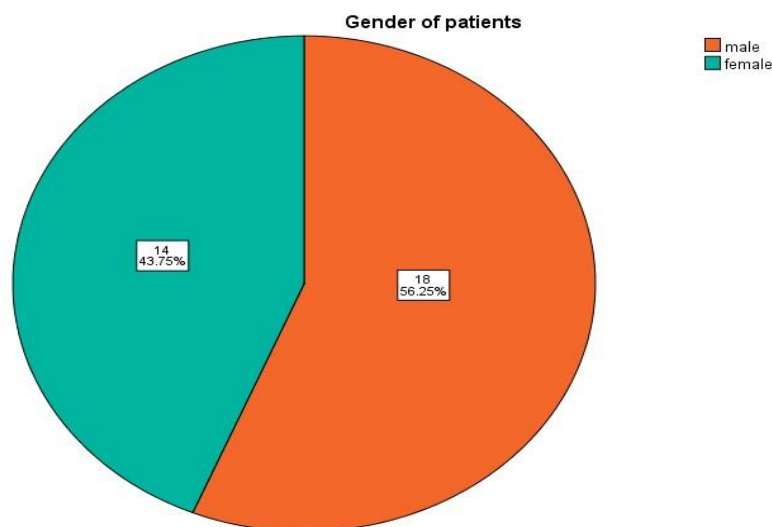


Figure 5 Gender of patient

Table 3 Frequency of height

Descriptive Statistics						
Height of patients	N	Mean	±	Std. Deviation	Minimum	Maximum
	32	5.55	±	0.28	5.10	6.10

Table 4.3 the descriptive statistics are shown for height of patient in which N= 32 and shown Mean $\pm$ SD (5.55 ± 0.28), minimum height of patient was 5.10 and maximum was 6.10.

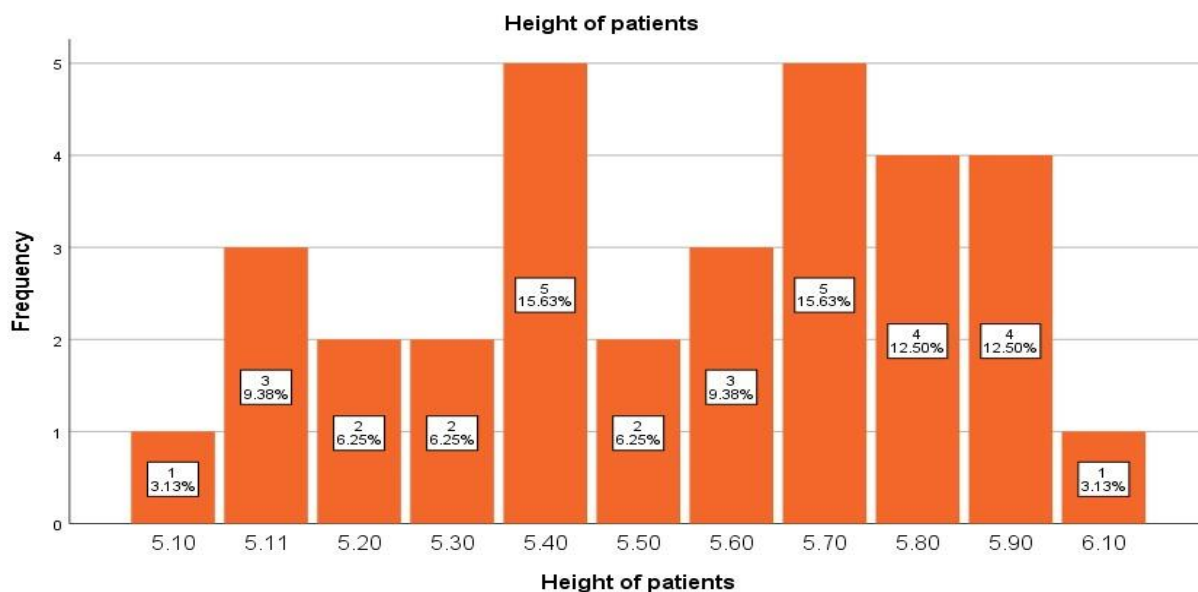


Figure 6 shows frequency distribution of height of patient

Table 4 Mean $\pm$ S.D of the Weight

DESCRIPTIVE STATISTICS				
Weight of patients	N	Mean $\pm$ Std. Deviation	Minimum	Maximum
	32	76.46 $\pm$ 8.08	60	90

Table 4.4 shown descriptive statistics of weight of patients in which N = 32, Mean $\pm$ SD (76.46 $\pm$ 8.08), minimum height was 60 and maximum height was 90.

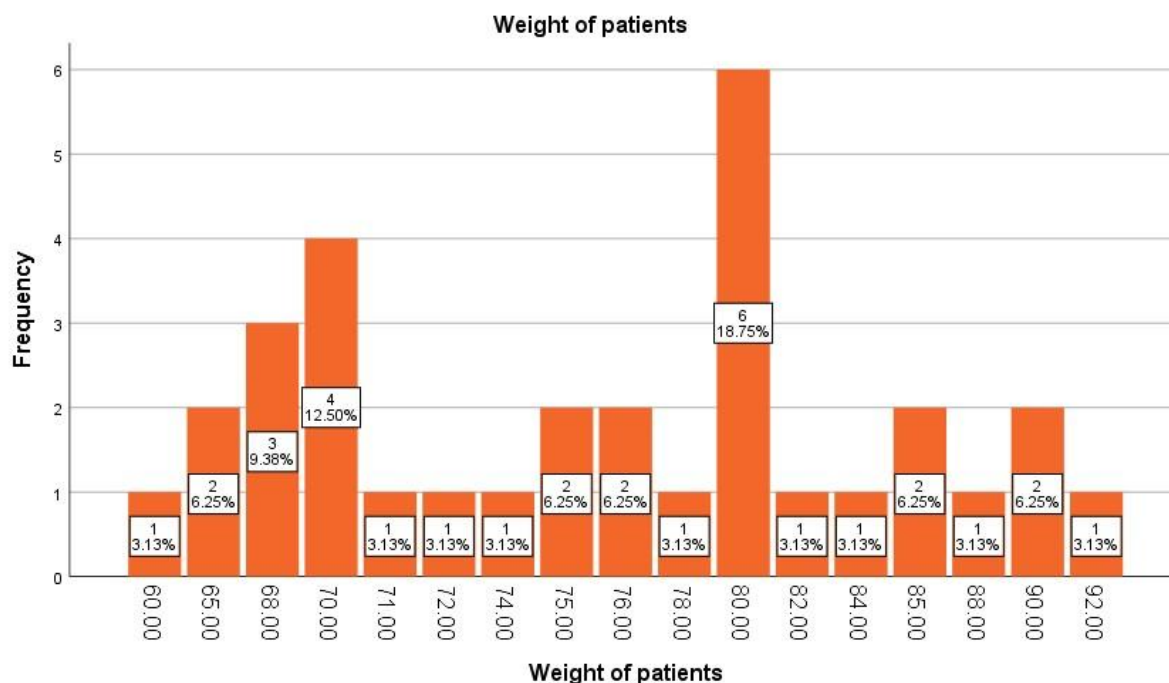


Figure 7 show frequency distribution of weight of the patients

Table 5 Normality Test

	Shapiro-Wilk		
	Statistic	df	Sig.
Visual Analogue Scale of patient at Pretreatment	.871	32	.001
Shoulder Pain and Disability Index of Patient at Pretreatment	.972	32	.561
Flexion of patient at Pretreatment	.934	32	.051

Extension of patient at Pretreatment	.707	32	.000
External Rotation of patient of Pretreatment	.903	32	.007
Internal Rotation of patient at Pretreatment	.943	32	.092

A Normal distribution or Non-Normal distribution of the data determined using the Shapiro-Wilk test. Table 4.5 indicate SPADI, Flexion and Internal rotation show p value more than 0.05 which specify

data was normally distributed (Parametric test) and VAS, Extension, and External show P value less than 0.05 which indicate data was not normally distributed (Non-Parametric test).

Within GROUP A

Table 6 Comparison of VAS within Group A

DESCRIPTIVE STATISTICS								
	N	M ± SD	Min	Max	Percentiles			P value
					25th	50th (Median)	75th	
Visual Analogue Scale of patient at pretreatment	16	6.87 ± .88	5.00	8.00	6.0000	7.0000	7.7500	.000
Visual Analogue Scale of patient at posttreatment	16	2.87 ± .95	1.00	4.00	2.0000	3.0000	4.0000	

Table 4.6 shows Wilcoxon test applied to check the effectiveness of the treatment in group A (PNF) to reduce pain. According to the table, Pretreatment mean± SD was (6.87± .885) and Post treatment

mean± SD was (2.87± .957). the p value of Group A (PNF) was less than α value (0.05) which indicate that PNF technique was effective in reducing pain in Group A (PNF) in Shoulder impingement syndrome.

Table 7 Comparing SPADI within in Group A

		N	M ± SD	P value
Pair 1	Shoulder Pain and Disability Index of Patient at Pretreatment	16	88.37 ± 8.08	.000
	Shoulder Pain and Disability Index of Patient at Post treatment	16	40.50 ± 7.84	

Table 4.7 shows Pair T-test applied to check the effectiveness of the treatment in group A (PNF) to reduce pain and improve ability. According to the

table, Pretreatment mean±SD was (88.37± .8.08) and Post treatment mean± SD was (40.50 ± 7.84). The P value of Group A (PNF) was less than α value (0.05)

which indicate that PNF technique was effective in reducing pain and improve ability in Group A (PNF) in Shoulder impingement syndrome.

Table 8 Comparison of Flexion within Group A

		N	M ± SD	P value
Pair 1	Flexion of patient at Pretreatment	16	109.0 ± 10.52	.000
	Flexion of patient at Post treatment	16	140.6 ± 7.71	

Table 4.8 shows Pair T-test applied to check the effectiveness of the treatment in group A (PNF) to improve range of motion. According to the table, Pretreatment mean± SD was (109.0 ± 10.52) and Post treatment mean± SD was (140.6 ± 7.71). The P value

of Group A (PNF) was less than α value (0.05) which indicate that PNF technique was effective in improving range of motion in Group A (PNF) in Shoulder impingement syndrome.

Table 9 Comparison of Extension within Group A

DESCRIPTIVE STATISTICS					
	N	M ± SD	Min	Max	P value
Extension of patient at Pretreatment	16	41.75 ± 20.14	25.00	96.00	.000
Extension of patient at Post treatment	16	58.75 ± 34.64	35.00	147.00	

Table 4.9 shows Wilcoxon test applied to check the effectiveness of the treatment in group A (PNF) range of motion. According to the table, Pretreatment mean± SD was (41.75 ± 20.14) and Post treatment

mean± SD was (58.75 ± 34.64). The P value of Group A (PNF) was less than α value (0.05) which indicate that PNF technique was effective in improving ROM in Group A in SIS.

Table 10 Comparison of External Rotation within Group A

Paired Sample Test				
		N	Mean ±S.D	P value
Pair 1	External Rotation of patient Pretreatment	16	51.87 ± 10.46	.000
	External Rotation of patient at Post treatment	16	68.75 ± 11.03	

Table 4.12 shows Paired T-Test applied to verify the effectiveness treatment in group A (PNF) to improve range of motion. According to the table, Pretreatment mean± SD was (51.87 ± 10.46) and Post treatment mean± SD was (68.75 ± 2.75). The P value of Group

A (PNF) was less than α value (0.05) which indicate that PNF technique was effective in improving range of motion in Group A (PNF) in Shoulder impingement syndrome.

Table 11 Comparison of Internal Rotation within Group A

Paired Sample Test				
		N	Mean ± S.D	P value
Pair 1	Internal Rotation of patient at Pretreatment	16	50.93 ± 5.23410	.000
	Internal Rotation of patient at Post treatment	16	67.18 ± 4.81966	

Table 4.13 shows Paired T-Test used to verify the effectiveness treatment in group A (PNF) to improve range of motion. According to the table, Pretreatment mean $\pm$ SD was (50.93 $\pm$ 5.23) and Post treatment

mean $\pm$ SD was (67.18 $\pm$ 4.81). The P value of Group A (PNF) was less than α value (0.05) which indicate that PNF technique was effective in improving ROM in Group A in Shoulder impingement syndrome.

WITHIN GROUP B:

Table 12 Comparison of VAS in Group B

DESCRIPTIVE STATISTICS								
	N	M $\pm$ SD	Min	Max	Percentiles			P value
					25th	50th (Median)	75th	
Visual Analogue Scale of patient at Pretreatment	16	6.68 $\pm$.94	5.00	8.00	6.0000	7.0000	7.0000	.000
Visual Analogue Scale of patient at Post treatment	16	4.18 $\pm$.75	3.00	5.00	4.0000	4.0000	5.0000	

Table 4.14 shows Wilcoxon test used to evaluate the effectiveness of the treatment in group B (Static Stretching) to reduce pain. According to the table, Pretreatment mean $\pm$ SD was (6.68 $\pm$ 0.94) and Post treatment mean $\pm$ SD was (4.18 $\pm$ 0.75). The P value of Group B (Static

Stretching) was less than α value (0.05) which indicate that Static Stretching technique was effective in improving range of motion in Group B in Shoulder impingement syndrome.

Table 13 Comparison of SPADI in Group B

Paired Sample Test				
		N	Mean ± Std. Deviation	P value
Pair 1	Shoulder Pain and Disability Index of Patient at Pretreatment	16	81.56 ± 6.96	.000
	Shoulder Pain and Disability Index of Patient at Post treatment	16	55.00 ± 10.91	

Table 4.15 shows Paired T-test used to assess the effectiveness of the treatment in group B (Static

Stretching) to reduce pain. According to the table, Pretreatment mean $\pm$ SD was (81.56 $\pm$ 6.96) and Post

treatment mean $\pm$ SD was (55.00 $\pm$ 2.72). The P value of Group B (Static Stretching) was less than α value (0.05) which indicate that Static Stretching technique was

effective in improving range of motion in Group B in Shoulder impingement syndrome.

Table 14 Comparison of Flexion within Group B

Paired Samples Statistics				
		N	Mean ± S.D	P value
Pair 1	Flexion of patient at Pretreatment	16	111.8 ± 13.40	.000
	Flexion of patient at Post treatment	16	128.7 ± 6.95	

Table 4.16 shows Paired T-Test applied to check the effectiveness treatment group B (Static Stretching) to improve range of motion. According to the table, Pretreatment mean $\pm$ SD was (111.8 $\pm$ 13.40) and Post treatment mean $\pm$ SD was (128.7 $\pm$ 6.95). The P value of Group B

(Static Stretching) was less than α value (0.05) which indicate that Static Stretching technique was effective in improving range of motion in Group B in Shoulder impingement syndrome.

Table 15 Comparison of Extension within Group B

DESCRIPTIVE STATISTICS								
	N	M $\pm$ SD	Min	Max	Percentiles			P value
					25th	50th (Median)	75th	
Extension of patient at Pretreatment	16	70.62 $\pm$ 48.57	20.00	130.00	30.00	37.50	120.00	.000
Extension of patient at Post treatment	16	79.62 $\pm$ 46.28	30.00	135.00	40.00	49.50	130.00	

Table 4.17 shows Wilcoxon test applied to check the effectiveness of the treatment in group B (Static Stretching) to improve range of motion. According to the table, Pretreatment mean $\pm$ SD was (70.62 $\pm$ 48.57) and Post treatment mean $\pm$ SD was (79.62 $\pm$ 46.28). The P value of Group B

(Static Stretching) was less than α value (0.05) which indicate that Static Stretching technique was effective in improving range of motion in Group B in Shoulder impingement syndrome.

Table 16 Comparison of External Rotation within Group B

Paired Samples Statistics				
		N	Mean $\pm$ Std. Deviation	P value
Pair 1	External Rotation of patient at Pretreatment	16	30.31 $\pm$ 5.31	.000
	External Rotation of patient at Post treatment	16	39.37 $\pm$ 8.34	

Table 4.20 shows Paired T-Test applied to check the effectiveness treatment within group B (Static Stretching) to improve range of motion. According to the table, Pretreatment mean $\pm$ SD was (30.31 $\pm$ 5.31) and Post treatment mean $\pm$ SD was (39.37 $\pm$ 8.34). The P value of Group B

(Static Stretching) was less than α value (0.05) which indicate that Static Stretching technique was effective in improving range of motion in Group B in Shoulder impingement syndrome.

Table 17 Comparison of Internal Rotation in Group B

Paired Samples Statistics				
		N	Mean $\pm$ SD	P value
Pair 1	Internal Rotation of patient at Pretreatment	16	38.75 $\pm$ 5.91608	.000
	Internal Rotation of patient at Post treatment	16	47.18 $\pm$ 9.65553	

Table 4.21 shows Paired T-Test used to check the effectiveness treatment within group B (Static Stretching) to improve range of motion. According to the table, Pretreatment mean $\pm$ SD was (38.75 $\pm$ 5.91) and Post treatment mean $\pm$ SD was (47.18 $\pm$ 9.65). The P value of Group B

(Static Stretching) was less than α value (0.05) which indicate that Static Stretching technique was effective in improving range of motion in Group B in Shoulder impingement syndrome.

Between group analysis

Table 18 Between Group comparison of VAS at baseline and Post treatment week 4th

Ranks				
	Treatment Group	N	Mean $\pm$ Sum of Rank	P value
Visual Analogue Scale of patient at Pretreatment	PNF (Group A)	16	17.34 $\pm$ 277.50	.590
	Static stretch (Group B)	16	15.66 $\pm$ 250.50	
	Total	32		
Visual Analogue Scale of patient at Post treatment	PNF (Group A)	16	11.00 $\pm$ 176.00	

	Static stretch (Group B)	16	22.00 ± 352.00	.001
	Total	32		

Table 4.22 shows descriptive statistics of VAS in Groups A and B at Baseline and Post treatment week 4th. Mann Whitney U test was applied to compare the effectiveness of two interventions. Pretreatment Mean rank ± sum of ranks of VAS of groups A and B was (17.34 ± 15.66) and (277.5 ± 250.5), respectively. At the baseline, P value was .590 which is greater than α value (0.05). Non-significant p value indicates that the both groups

were similar at baseline. Post treatment Mean rank ± sum of ranks of VAS of groups A and B was (11.00 ± 22.00) and (176.0 ± 352.0), respectively. Post treatment p value was approximately (.001) which is less than α (0.05). Significant p value indicate that the VAS of both groups at the 4th week of post-treatment showed a significant difference. PNF is more superior as compared to Static Stretching.

Table 19 Between Group comparison of SPADI at baseline and Post treatment week 4th

Independent Sample Test				
	Treatment Group	N	M ± SD	P value
Shoulder Pain and Disability Index of Patient at Pretreatment	PNF (Group A)	16	88.37 ± 8.08	.161
	Static stretch (Group B)	16	84.50 ± 7.13	
Shoulder Pain and Disability Index of Patient at Post treatment	PNF (Group A)	16	40.50 ± 7.84	.000
	Static stretch (Group B)	16	59.31 ± 13.20	

Table 4.23 shows Paired T-Test of SPADI in Group A and B at Baseline and Post treatment week 4th. Paired T- test was used to compare the effectiveness of both interventions. Pretreatment Mean ± Standard Deviation SPADI of group A and B was (88.37 ± 8.08) and (84.50 ± 7.13), respectively. At the baseline, P value was .161 which is greater than α value (0.05). Non-Significant P value indicates that

both groups were similar at baseline. Post treatment Mean ± S.D of SPADI of group A and B was (40.50 ± 7.84) and (59.31 ± 13.20), respectively. Post treatment P value was approximately (.000) which was less than α (0.05). Significant P value show that there was significant variation in SPADI of two groups at post treatment week 4th. PNF is more superior as compared to Static Stretching.



Table 20 Between Group comparison of Extension at baseline and Post treatment week 4th

Group Statistics				
	Treatment Group	N	M ± SD	P value
Flexion of patient at Pretreatment	PNF (Group A)	16	109.0 ± 10.52	.514
	Static stretch (Group B)	16	111.8 ± 13.40	
Flexion of patient at Post treatment	PNF (Group A)	16	140.6 ± 7.71	.000
	Static stretch (Group B)	16	128.7 ± 6.94	

Table 4.24 shows Paired T-Test of Flexion in Group A and B at Baseline and Post treatment week 4th. Paired T-Test were evaluate to compare the effectiveness of both interventions. Pretreatment Mean ± S.D SPADI of group A and group B was (109.0 ± 10.52) and (111.8 ± 13.40), respectively . At the baseline, P value was (.514) which is greater than α value (0.05). Non-

significant P value show that both groups were similar at baseline. Post treatment Mean ± Standard Deviation of SPADI of group A and B was (140.6 ± 7.71) and (128.7 ± 6.94), respectively. Post treatment P value was approximately (.000) which was less than α (0.05). Significant P value indicate that there were Significant difference in Flexion of two groups at post treatment week 4th. PNF is more superior as compared to Static Stretching.

Table 21 Between Group comparison of Extension at baseline and Post treatment week 4th

Ranks				
	Treatment Group	N	Mean Rank ± Sum of Ranks	P value
Extension of patient at Pretreatment	PNF (Group A)	16	51.87 ± 10.47	.609
	Static stretch (Group B)	16	30.31 ± 5.31	
	Total	32		
Extension patient at Post treatment	PNF (Group A)	16	68.75 ± 11.03	.004
	Static stretch (Group B)	16	8.341 ± 8.34	
	Total	32		

Table 4.25 show Rank of Extension in Group A and Group B at Baseline and Post treatment week 4. Paired T-Test was applied to compare the effectiveness both interventions. Pretreatment Mean rank ± sum of ranks of Extension of group A and group B was (15.66 ± 250.5) and (277.50 ± 17.34), respectively . At the baseline, P value was .609 which is greater than α value (0.05). Non-Significant P value indicates that both groups were similar at baseline. Post treatment Mean rank ± sum

of ranks of Extension of group A and group B was (11.72 ± 187.5) and (340.50 ± 21.28), respectively .Post treatment p value was approximately (.004) which is less than α (0.05). Significant p value indicate that there was notable difference in Extension of two groups at post treatment week 4th. Static Stretching is more superior as compared to PNF.



Table 22 Between Group comparison of External Rotation at baseline and Post treatment week 4th

Group Statistics				
	Treatment Group	N	Mean $\pm$ Std. Deviation	P value
External Rotation of patient at Pretreatment	PNF (Group A)	16	51.87 $\pm$ 10.46	.000
	Static stretch (Group B)	16	30.31 $\pm$ 5.31	
External Rotation of patient at Post treatment	PNF (Group A)	16	68.75 $\pm$ 11.03	.000
	Static stretch (Group B)	16	39.37 $\pm$ 8.34	

Table 4.28 show Group Statistics of External Rotation in Group A and Group B at Baseline and Post treatment week 4th. Paired T-test was applied to compare the effectiveness of both interventions. Pretreatment Mean $\pm$ S.D of External Rotation of group A and group B was (51.87 $\pm$ 10.46) and (30.31 $\pm$ 5.31), respectively . At the baseline, P value was .000 which is less than α value (0.05). Non-significant P value indicates that the both groups

were similar at baseline. Post treatment Mean $\pm$ S.D of External Rotation of group A and group B was (68.75 $\pm$ 11.03) and (39.37 $\pm$ 58.34), respectively .Post treatment p value was approximately (.000) which is less than α (0.00). Significant p value indicate that there were Significant difference in A External Rotation of both groups at post treatment week 4th. PNF is more superior as compared to Static Stretching.

Table 23 Between Group comparison of Internal Rotation at baseline and Post treatment week 4th

Group Statistics				
	Treatment Group	N	Mean $\pm$ Std. Deviation	P value
Internal Rotation patient Pretreatment of at	PNF (Group A)	16	50.93 $\pm$ 5.23	.000
	Static stretch (Group B)	16	38.75 $\pm$ 5.91	
Internal Rotation patient at Post treatment of	PNF (Group A)	16	67.18 $\pm$ 4.81	.000
	Static stretch (Group B)	16	47.18 $\pm$ 9.65	

Table 4.29 show Group Statistics of Internal Rotation in Group A and Group B at Baseline and Post treatment week 4th. Paired T-test was applied to compare the effectiveness of both interventions. Pretreatment Mean $\pm$ S.D of Internal Rotation of group A and group B was (50.93 $\pm$ 5.23) and (38.75 $\pm$ 5.91), respectively . At the baseline, P value was .000 which is less than α value (0.05). Non-significant P value indicates that the both groups were similar at baseline. Post treatment Mean $\pm$ S.D of Internal Rotation of group A and group B was (67.18 $\pm$ 4.81) and (47.18 $\pm$ 9.65), respectively .Post

treatment p value was approximately (.000) which is less than α (0.00). Significant p value indicate that there was notable difference in A Internal Rotation of both group A and B at post treatment week 4th. PNF is more superior as compared to Static Stretching.

DISCUSSION

The study design was a randomized control trial aimed at comparing static stretching and Proprioceptive neuromuscular facilitation (PNF) for treating individuals with shoulder impingement



syndrome, characterized by shoulder pain and limited range of motion. Participants were recruited through purposive sampling and randomized into two groups using a lottery method. Sixty participants were assessed for eligibility, with 28 excluded from the study. The final participants, aged 18 to 75 years, were diagnosed with positive impingement tests (Neer test and Hawkins-Kennedy test) and experienced increased pain during flexion or abduction of the symptomatic shoulder. Exclusion criteria included a history of clavicle, scapula, or humerus fractures, systemic illness, bone disease, congenital anomalies, active infections, or malignancies in the shoulder region. All variables were normally distributed and analyzed using parametric tests with a significance level of 0.05, as determined by the Shapiro-Wilk test. The study concluded that static stretching was more effective than PNF for reducing shoulder discomfort and enhancing range of motion in individuals with shoulder impingement syndrome following therapy. Rahman et al. (2024) conducted a randomized control trial comparing the effects of two upper limb flexion patterns (Diagonal 1 and Diagonal 2) on stroke patients with scapular dyskinesis. Both interventions improved range of motion (ROM) and reduced discomfort, but no significant difference was found between the two groups. In contrast, my study found that proprioceptive neuromuscular facilitation (PNF) was more effective than static stretching in reducing pain and improving ROM in shoulder impingement syndrome (SIS). This suggests that while both approaches may benefit shoulder rehabilitation, PNF offers superior outcomes in treating SIS due to its focus on enhancing joint stability and movement. Reyhani et al. (2024) conducted a cross-sectional study on athletes with scapular dyskinesis, finding that it significantly affected shoulder proprioception but did not impact handgrip strength or stability. While their study highlights the influence of proprioception on shoulder function, it does not directly compare therapeutic interventions. In contrast, my study demonstrated that proprioceptive neuromuscular facilitation (PNF) was more effective than static stretching in improving range of motion and reducing pain in individuals with shoulder impingement syndrome. This suggests that PNF may

not only enhance proprioception but also actively improve functional outcomes in shoulder rehabilitation.

Tauqeer et al. (2024) conducted a randomized control trial examining the effects of exercise and manual therapy on functional ability and scapular protraction. They found significant improvements in scapular range of motion and functional capacity. Similarly, my study showed that PNF was more effective than static stretching in improving shoulder range of motion and functional outcomes for shoulder impingement syndrome. However, while Tauqeer et al. did not observe significant improvements in pain in their control group, my study found PNF to be more effective in reducing pain, suggesting PNF may offer additional benefits in pain relief for shoulder conditions.

Zhong et al. (2024) conducted a randomized control trial meta-analysis and found that, while the experimental group showed greater improvement in pain reduction (measured by Visual Analog Scale) compared to traditional physical therapy, there was no significant difference in range of motion between the two groups. In contrast, the current study demonstrated that Proprioceptive neuromuscular facilitation (PNF) was more effective than static stretching in improving both pain and range of motion in individuals with shoulder impingement syndrome (SIS). This suggests that PNF may provide more comprehensive benefits for SIS compared to other therapies like SSE.

Ishaq et al. (2024) conducted a study on subacromial pain syndrome using muscle energy techniques (MET) and mobilization with movement (MWM) in two patient groups. Their research showed that both techniques significantly alleviated symptoms, reduced pain, and improved range of motion. In contrast, the current study demonstrated that proprioceptive neuromuscular facilitation (PNF) is more effective than static stretching (SS) for reducing pain and improving range of motion in patients with shoulder impingement syndrome. While both studies support the effectiveness of manual and therapeutic techniques, the current study highlights PNF's superiority in treating shoulder impingement, suggesting that PNF may offer more targeted benefits compared to broader approaches like MET or MWM.



Wahyuni and Randa (2024) conducted a study focusing on strengthening and stretching exercises for subacromial pain syndrome, demonstrating short-term pain reduction and improved function through rotator cuff and scapular strengthening activities. While their study supports the effectiveness of stretching exercises, the current research highlights that proprioceptive neuromuscular facilitation (PNF) was more effective than static stretching for improving range of motion and reducing pain in shoulder impingement syndrome. This difference suggests that while stretching has its benefits, PNF provides a more comprehensive approach in addressing both pain and functional outcomes in shoulder impingement patients.

Yousfvand et al. (2023) conducted a study that demonstrated significant improvements in pain and functional impairment in male bodybuilders with shoulder impingement syndrome through corrective exercises. In contrast, my current research found that proprioceptive neuromuscular facilitation (PNF) is more effective than static stretching for treating shoulder impingement syndrome, suggesting superior benefits in reducing pain and enhancing range of motion. The inclusion of a diverse age range in my study enhances the generalizability of these findings, emphasizing the need for tailored rehabilitation approaches in clinical practice. Overall, both studies highlight the importance of effective treatment modalities for improving patient outcomes in shoulder conditions.

Karaaslan et al. (2023) conducted a randomized controlled trial comparing exercise training with and without neuromuscular electrical stimulation in patients with subacromial impingement syndrome, finding improvements in range of motion and shoulder function without significant benefits from the added stimulation. In contrast, my current study demonstrated that proprioceptive neuromuscular facilitation (PNF) is more effective than static stretching for reducing pain and enhancing range of motion in individuals with shoulder impingement syndrome. This suggests that specific therapeutic techniques like PNF may offer greater benefits than traditional methods in rehabilitation practices.

Bhavika and Vinosh Kumar (2023) found that both scapular mobilization with conventional physiotherapy and scapular PNF improved shoulder

range of motion and reduced pain in individuals with adhesive capsulitis. In contrast, my current study indicates that PNF is more effective than static stretching for treating shoulder impingement syndrome (SIS). This suggests that while combining treatments can be beneficial, PNF alone may provide superior outcomes for specific conditions like SIS. Both studies highlight the importance of tailored interventions, emphasizing the need for further research to refine treatment strategies for various shoulder issues.

Altaf et al. (2023) conducted a randomized control study on scapular dyskinesia, finding significant improvements in pain and shoulder impairment with proprioceptive neuromuscular facilitation (PNF) compared to traditional therapy. In contrast, my current study found that PNF is more effective than static stretching for treating shoulder impingement syndrome (SIS), particularly in reducing pain and enhancing range of motion. This suggests that the dynamic aspects of PNF may specifically benefit individuals with SIS more than static stretching. While both studies highlight the effectiveness of PNF, my research emphasizes its superiority over static stretching in managing shoulder impingement. These findings underscore the need for tailored rehabilitation strategies based on specific shoulder conditions to optimize treatment outcomes.

Alfaya et al. (2023) conducted a study on shoulder proprioception and its link to functional impairment in patients with subacromial impingement syndrome, finding significant pain during abduction and positive results on shoulder dysfunction tests. In contrast, my current research demonstrated that proprioceptive neuromuscular facilitation (PNF) is more effective than static stretching in reducing discomfort and enhancing range of motion. While Alfaya et al. emphasized the importance of assessing proprioceptive deficits, my study supports the use of PNF as a superior treatment approach. Together, these findings highlight the need for targeted rehabilitation strategies that address both proprioceptive issues and effective therapeutic modalities to improve patient outcomes.

İğrek and Çolak (2022) conducted a randomized control trial involving three groups to evaluate the effectiveness of PNF exercises and soft mobilization alongside conventional therapy for subacromial

impingement syndrome. Their study found that while all groups showed significant improvements in pain and functionality, neither PNF nor soft mobilization yielded better outcomes than the control group. In contrast, my current research indicates that PNF is more effective than static stretching for treating shoulder impingement syndrome. This discrepancy may suggest that the specific application of PNF in my study provides more pronounced benefits for reducing pain and enhancing range of motion than the combined approaches evaluated by İğrek and Çolak.

Saeed et al. (2022) conducted a quasi-experimental study on patients with scapular dyskinesis and adhesive capsulitis, comparing the effects of proprioceptive neuromuscular facilitation (PNF) and myofascial release techniques. Their findings showed that both techniques significantly improved pain and function, with PNF demonstrating greater efficacy. In contrast, the current study highlights that PNF is more effective than static stretching for treating shoulder impingement syndrome (SIS). This consistency suggests that PNF may be a superior intervention for enhancing shoulder function across various conditions. The effectiveness of PNF in both adhesive capsulitis and SIS reinforces its potential benefits in rehabilitation protocols for patients with shoulder dysfunction.

Moslehi et al. (2021) conducted a study on shoulder impingement syndrome (SIS) that involved three patient groups, demonstrating that an integrated rehabilitation program effectively reduced discomfort and improved functionality. In contrast, my current study found that proprioceptive neuromuscular facilitation (PNF) was more effective than static stretching for treating SIS, highlighting the importance of specific therapeutic techniques. While Moslehi et al. emphasized comprehensive rehabilitation strategies, my findings suggest that PNF provides a more targeted approach to enhance shoulder mobility and reduce pain. This underscores the need for clinicians to consider the specific benefits of each technique when designing treatment protocols for SIS, reinforcing the necessity for further research into effective therapeutic interventions.

6.1 SUMMARY:

The most prevalent complaint among patients in shoulder impingement syndrome due to older age, rotator cuff pathology and overhead activities. The aim of this study was to determine the comparative effects of static stretching and Proprioceptive neuromuscular facilitation on shoulder pain and range of motion in shoulder patients. For this purpose, a randomized clinical trial was carried out and an ethical letter was signed by Abwa hospital, Move better clinic and Faisal hospital. 35 patients were participated from these hospitals. After informed consent and complete evaluation, individuals who fulfill inclusion criteria were included in the study. Two groups were formed and each consisted of 16 patients. All patients participated in the study with 3 dropouts. After giving baseline treatment (TENS), PNF (Proprioceptive neuromuscular facilitation) was applied to group A while static stretching was applied to group B. Data was collected at baseline, following the second and fourth treatment weeks. VAS scale for pain and SPADI scale were used for shoulder disability and goniometer was used to check range of motion. There were 14 females (43.8%) and 18 males (56.3%) in the sample. Mean value of VAS at baseline of group A was 6.87 ± 0.885 and mean value of group B at baseline was 6.68 ± 0.94 . The mean value of post-treatment after 4th week of VAS of group A was 2.87 ± 0.957 and mean value of VAS at post-treatment after 4th week of group B was 4.18 ± 0.75 . Mean value of SPADI at baseline of group A was 88.37 ± 0.808 and mean value of SPADI of group B at baseline was 81.56 ± 6.96 . The mean value of post-treatment after 4th week of SPADI of group A was 40.50 ± 7.84 and mean value of SPADI at post-treatment after 4th week of group B was 55.00 ± 2.72 . The mean value of flexion at baseline of group A was 109.0 ± 10.52 and mean value of flexion of group B at baseline was 111.8 ± 13.40 . The mean value of post-treatment after 4th week of flexion of group A was 140.6 ± 7.71 and mean value of flexion at post-treatment after 4th week of group B was 128.7 ± 6.95 . The mean value of extension at baseline of group A was 41.75 ± 20.14 and the mean value of extension at baseline of group B was 70.62 ± 48.57 . The mean value of post-treatment after 4th week of extension of group A was 58.75 ± 34.64 and mean value of extension at post-treatment after 4th week of group



B was 79.62 ± 46.28 . The Mean value of external rotation at base line of group A was 51.87 ± 10.46 and mean value of external rotation of group B at baseline was 30.31 ± 5.31 . The mean value of post treatment after 4th week of external rotation of group A was 68.75 ± 2.75 and mean value of external rotation post treatment after 4th week of group B was 39.37 ± 8.34 . The Mean value of internal rotation at base line of group A was 50.93 ± 5.23 and the mean value of internal rotation of group B at was 38.75 ± 5.19 . The mean value of post treatment after 4th week of internal rotation of group A was 67.18 ± 4.18 and mean value of inter internal rotation at post treatment after 4th week of group B was 47.18 ± 9.65 . The mean of between group comparison of visual analogue scale of group A was 17.34 ± 15.66 and group B was 277.5 ± 250.5 at baseline, At post treatment the mean value of comparison of group A and B was 11.00 ± 22.00 and 176.0 ± 352.0 . The p value of VAS in between group comparison is .001, SPADI .000, flexion.000, extension.004, external rotation.000 and internal rotation.000. Through group analysis showed a relevant significant improvement in shoulder people with shoulder pain, Group A PNF is a more efficient alternative to therapy for alleviating pain and enhancing ROM in shoulder impingement individual.

6.2 CONCLUSION, STRENGTH, LIMITATIONS AND RECOMMENDATIONS

6.2.1 CONCLUSION:

Both techniques were effective but the current Investigation found that the technique known as PNF was successful in relieving Pain and Range of Motion and showed significant improvement in lowering discomfort and functioning in shoulder people with shoulder impingement syndrome.

6.2.2 STRENGTH:

- No study on shoulder individual regarding the topic of PNF and static stretching on shoulder impingement syndrome patient. Therefore, it adds knowledge to literature.
- This study provided information that static stretching is more effective then proprioceptive

neuromuscular facilitations (PNF) for the treatment of shoulder impingement people.

6.2.3 LIMITATIONS

- Many participants did not understand the study protocols due language barrier that was a limitation.
- Many participants had not shoulder pain so many participants were excluded from the study.
- Lack of cooperation and less interest of participants were also the limitation.
- This study was conducted at limited places.

6.2.4 RECOMMENDATIONS

- We recommended future researchers to take functional ability as outcome measures.
- Utilized advance imaging techniques to assess structural changes in the shoulder joint alongside clinical outcomes.
- Increase participants number to enhance the statistical power and generalizability of the finding.
- Implement randomized controlled trials with alternative treatment groups to better isolate the effects of the spencer met and scapular exercises.

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