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ROLE OF MANUAL THERAPY COMBINED WITH EXERCISE IN SUBACROMIAL IMPINGEMENT SYNDROME

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Abstract

The primary objective of the present study is to evaluate the effectiveness of Manual therapy with specified exercises in reducing pain, function disability and improving ROM in individuals affected with subacromial impingement syndrome. Pre and post evaluation was performed on 30 participants using the goniometer and shoulder pain disability index (SPADI). The findings suggest a significant reduction in pain level and improvement in range of motion and functional abilities following the intervention. These data suggest that the application of Manual therapy with specified exercises is effective intervention for treating subacromial impingement syndrome.

INTRODUCTION

The shoulder joint plays an important role in the function of the upper limb and in the activities of daily living[1,2]. Human shoulder movements involve a highly coordinated and complex interaction between muscles, ligaments, and bones. Both static and dynamic stabilizing structures contribute to maintaining joint stability while allowing the shoulder to achieve the greatest range of motion among all joints in the human body[3]. This wide mobility enables the upper limb to position the hand and elbow effectively in space and allows individuals, particularly athletes, to perform a variety of

sports-related activities. However, such extensive mobility also increases the susceptibility of the joint to injury.The structural design of the glenohumeral joint includes a relatively large humeral head articulating with a comparatively small glenoid cavity, which results in reduced inherent bony stability. Unlike the hip joint, which has a deeper and more congruent ball-and-socket configuration, the shoulder depends significantly on surrounding ligaments and muscular structures to maintain stability throughout its range of motion. When any of these static or dynamic stabilizers are compromised due to trauma or repetitive overuse, the risk of shoulder injury increases substantially[4,5]. Shoulder pathologies are very common with the lifetime risk[1,6]. Subacromial impingement syndrome (SAIS) is considered the most frequently reported shoulder disorder accounting for 27% of total shoulder disorder[7]. It is not a single condition but rather a spectrum of pathologies, ranging from subacromial bursitis to rotator cuff tendinopathy and, in severe cases, full-thickness rotator cuff tears[8,9].

The subacromial space is anatomically bordered by the humeral head inferiorly, and superiorly by the anterior third of the acromion the coracoacromial ligament, and the acromioclavicular joint. Within this space lie key structures such as the supraspinatus tendon, the subacromial bursa, the tendon of the long head of the biceps brachii, and the joint capsule of the shoulder. Any of these may become involved when SAIS develops [3,4,5]. Both extrinsic compression and intrinsic degeneration often act together in the development of SAIS. Management strategies typically begin with conservative approaches such as physiotherapy and corticosteroid injections, while surgical intervention is reserved for patients who do not respond to non-operative treatment but in this study we focus on physical therapy management that includes interventions are being used by physical therapists including exercises, manual therapy for the management of SAIS. Therapeutic exercise plays a key role in improving shoulder function. It typically involves a structured combination of scapular stabilization, rotator cuff strengthening, range of motion (ROM) exercises, proprioceptive neuromuscular facilitation (PNF), and stretching techniques. Together, these interventions help restore movement, enhance muscle control, and improve overall shoulder performance.

Manual therapy[10] is a skilled, passive movements performed by a clinician, targeting specific anatomical structures or related systems. Its primary aim is to bring about beneficial changes in the patient's perception of pain. The selection and application of MT techniques are based on clinical reasoning, allowing practitioners to address musculoskeletal pain from multiple dimensions and thereby enhance treatment outcomes and the benefits of manual therapy are thought to arise through a combination of biomechanical, neurophysiological, psychological, and patient-related nonspecific factors. These elements provide a framework for understanding the mechanisms and processes through which MT exerts its effects[10,11,12,13].

Myofascial Release Therapy (MFR) is a manual physiotherapy technique used to alleviate tension within muscles and the surrounding Myofascial tissues. The technique involves the application of slow, sustained pressure and gentle stretching to the affected soft tissues. This approach helps release fascial restrictions, reduce muscular tension, and relieve pain experienced by patients[14]. Myofascial release is frequently applied in the management of a variety of pain-related conditions, including muscle tightness, muscular pain, joint discomfort, headaches, neck pain, and back pain. The therapeutic method works by applying prolonged pressure to the fascial system, which helps decrease tissue stiffness and restore normal tissue mobility[14,15,16].

Joint Mobilization[17] (JM) is a manual therapy[10] technique widely used in physiotherapy to reduce pain and improve joint mobility. This intervention involves the application of controlled passive movements to a joint with the aim of restoring normal motion and reducing discomfort. Joint mobilization is used both as an assessment and treatment method for joint dysfunction. The primary objective of joint mobilization is to restore normal joint play and facilitate proper rolling and gliding movements between articular surfaces, thereby enabling functional, pain-free joint motion[18,19,20,21].

In this study, we included two primary outcome measures to assess the effectiveness of the intervention: the shoulder pain and disability index(SPADI) and goniometric measurements. The SPADI scale is use to evaluate the participants' perceived shoulder-related symptoms, pain, function in daily living and shoulder-related quality of life[22,23]. In addition, a goniometer is introduce to objectively measure the range

of motion of the shoulder joint, providing valuable quantitative data on joint flexibility and mobility[24,25].Therefore, the aims of our study were to evaluate the effectiveness of a SIX-week physical therapy and rehabilitation program with manual therapy combined with a specific exercises programme on pain, quality of life and function in treatment of Subacromial Impingement Syndrome.The study will also contribute significantly to future research by providing a strong foundation and the result will also promote evidence based practice by adding valuable insights to the existing body of knowledge.

AIM & OBJECTIVES OF THE STUDY

- To assess the efficacy of manual therapy in rehabilitation to improve pain and disability in the treatment of sub-acromial impingement syndrome.
- To assess the effectiveness of exercise in rehab to improve ADL (Activity of daily living), strength and balance in the treatment of sub-acromial impingement syndrome.

MATERIALS AND METHODOLOGY

The cross sectional research design was used in study. A cross sectional study is a sort of observational research in which data is collected at a single moment in time to evaluate the relationship between variables. The study used randomized sampling as its sample design. The participants were affected with Subacromial Impingement Syndrome. These individuals were involved in the study to see how manual therapy (including MFR, MOBILIZATION) with specific exercises program affected their condition.

Paper and pencil for data recording, chair for participants to sit on during assessment and treatment, a treatment couch, Thera band, goniometer, assessment form consent form, towel for comfort or support were all used in the study.

SELECTION CRITERIA:

Inclusion Criteria: The study would likely include patients who meet specific criteria such as:

- Informed consent/ willingness to participate in the study
- Age group 18 – 40
- Males and females with shoulder impingement syndrome.

Diagnosed with special orthopedic test (Empty Cane test, Drop Arm Test, Yergason's Test)

Exclusion Criteria: Certain factors exclude patients from the study, such as:

- Patients with diabetes
- Patient with recent fracture / stress fracture
- Any unhealed wound present at treatment site
- Age group less than 18 and more than 40
- Neurological Disorders
- Orthopedic Surgeries: History of orthopedic surgery in the last year related to shoulder

SAMPLE SIZE AND STUDY DURATION

For this study the sample size was 30 people the individual were chosen at random from the research population to guarantee representativeness and adequate data for analysis. The Study was carried out (5 times a week) for six weeks, individuals in a clinical environment had therapy as part of the study in pacific college of physiotherapy, pacific medical university (Udaipur), after obtaining ethical committee approval dated 6-10-2025, PMU/IEC/MPT/2025. All participants completed information and consent form at recruitment. This time frame allowed for evaluation of subjects response to the therapy as well as any changes in their pain, range of motion and functional ability. Each session was scheduled for 40-45 minutes. This period was set aside to ensure the patient had enough time to execute the procedure correctly.

PROCEDURE

Permission for conduct Study is taken from the institutional ethical committee of PMCH **(PMU/IEC/MPT/2025)**, Pacific medical university bhilo ka bedla Udaipur(RAJ).

Individuals Diagnosed with shoulder impingement syndrome by the Physiotherapy department, Orthopedic department OPD; initially assessed for the inclusion or exclusion criteria. Prior to the treatment procedure, all participants were informed about the purpose, procedures, potential benefits, and possible risks of the study. Written informed consent was obtained from each participant prior to enrollment.

- 30 subjects were selected on the basis on inclusion criteria treated

with manual therapy and exercise therapy.

Week 1–2: Manual Therapy

- Soft tissue mobilization: Upper trapezius, levator scapulae, posterior cuff.
- Glenohumeral joint mobilizations: Grade I–II (inferior & posterior glide) for pain relief.
- Scapular mobilizations: Protraction/retraction, upward/downward rotation.
- Cervical/thoracic mobilization if stiffness contributes.

Week 3–4: Manual Therapy

- Posterior/inferior glenohumeral mobilizations.
- Thoracic spine mobilization to enhance extension.
- Soft tissue release of pec minor and infraspinatus.

Week 5–6 : Manual Therapy

- Maintenance mobilization: GH posterior/inferior glides.
- Myofascial release: Pec major/minor, latissimus if tight.

Combined exercise programme for both the group

- **Pendulum exercises** – Ask the patient to stand to the side of the table or couch and bend forward to at the waist keeping back straight. Unaffected arm is placed on the couch and affected arm is hanging downward. Instruct the patient to swing the arm slowly forward hai backward like a pendulum.
- **Passive & AAROM**: patient is positioned in supine lying and the therapist stands to the side of the couch. Therapist one hand supports the patients elbow and forarm and another hand is support the wrist and arm. Therapist slowly lift the arm in Flexion, abduction, external rotation in pain-free range or progresses to active assisted in which therapist ask the patient to lift the arm in flexion, abduction and external rotation and provide gentle assistance to complete the movement.
- **Isometrics**: Patient is positioned supine lying and place the arm by the side of body. Ask the patient to slightly flex the elbow and make a fist and now the therapist place the hand just over the fist and instruct the patient to try to move arm in flexion while the therapist resist the

movement(isometric flexion).

Patient is positioned standing facing wall with elbow straight. Keep elbow aligned directly below the shoulder wit the dorsum of hand facing the wall, press forward into the wall holf for 10 sec seconds and release slowly. Now stand about 6 inches from the wall and body should be perpendicular to the wall make a fist and gently press it into the wall and hold for 10 sec. Now the patient back facing the wall. Patient shoulde make k fistand gently presses into the wall and hold for 10 sec.

- **Scapular exercises** – Patient is positioned in erect standing position. Tie the resistance band to the door handle and hold it in both ends ask the patient to do shoulder blades back. Pull the blades back and let the elbow bend. Hold for 5 sec and let the arms come forwards.
- **Chin tuc-** Patient position- sitting. Ask the patient to keep the neck and shoulder relaxed. Look straight and gently glide the chin back and tuc the chin in neck area with gentle breath. Hold it for 5 sec and bring the chin forward again.
- **Theraband strengthening**:

Biceps theraband- Patient position- standing position. Step on a resistance band with one foot hold the band with same side hand, just above the thigh. Use biceps to curl the band up until it reaches to the shoulder.

Triceps exercise with theraband- Patient position – standing position. Place the theraband around the neck grip the one of the end loop in each hand keep the elbows and wrist straight. Straighten the arms by pushing hands down while squeezing triceps.

Shoulder internal rotation with theraband- Patient position –standing position. Tie the one end of resistance band on the middle of the door or something stable object. Place a rolled up towel under the arm. keep the wrist straight bend the elbow at the side (90degree) grasp the other hand of the band across the body . and forearm parallel to the ground. Hold for 5-10 seconds and slowly return.

Shoulder external rotation with theraband- Ptient position – standing position begin with the one end securely attached at waist side. Place

a towel roll under the arm grasp the other end of the band with tension pull the band away from the body or away from the wall rotating the forearm outward. Hold for 5-10 seconds and return slowly.

- **Shoulder Scaption**- Patient position standing or sitting. Ask the patient to lift the arms by his/her side bring them forward at a 30-45 degree angle.
- **Closed kinetic chain stability(Wall push-ups):**Patient position – Standing. Ask the patient to stand facing the wall. Maintain a distance of the one arm from the wall and place the both palm on the wall at the shoulder level. Instruct the patient to slightly bend the elbow bring the body towards the wall and push the body away from the wall by straightening of elbow
- **Functional tasks**: Reaching, lifting (within tolerance).

RESULTS

A total of 30 participants were included in the study, 17 females and 13 males. In the 18–24 years age group 7 participants, 25–30 years age group,13 participants, 31–35 years age group, 6 participants, 36–40 years age group, 4 participants were participated.

Table 1: Shoulder Abduction (Goniometer)

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	F (t)	Sig. (p-value)
Pre (0 week)	30	89	107	98.2	4.76		
Post (6 week)	30	120	140	129.7	5.24	22.61*	0.000 (p < .001)
Overall	60	89	140	113.95	16.54		

Graph 1: Shoulder Abduction (Goniometer)

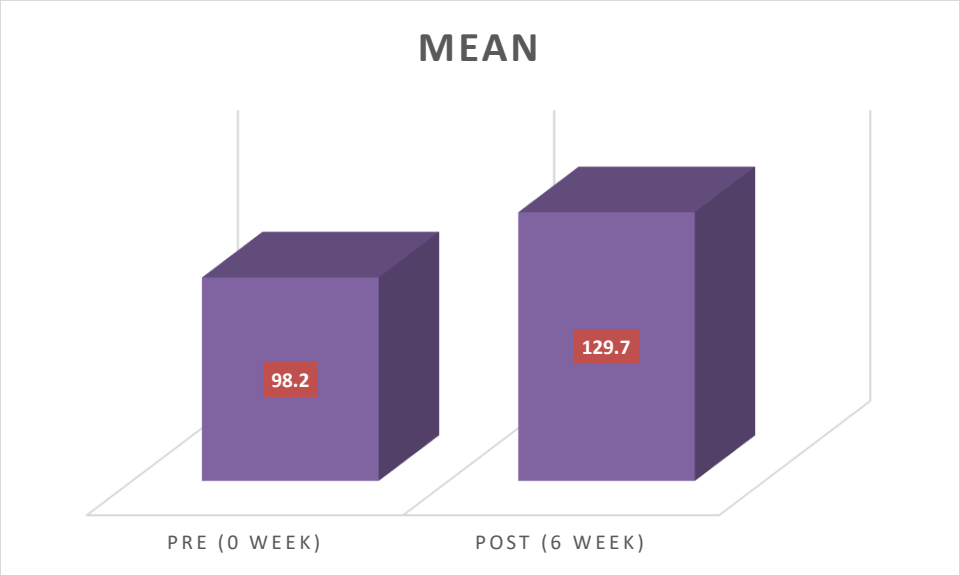

Table 1 and Graph 1 show the shoulder abduction range of motion for participants at pre-treatment and post-treatment. At pre-treatment (0 week), the mean shoulder abduction was 98.2°, with a minimum of 89° and a maximum of 107°. The standard deviation of 4.76° indicates that the participants' baseline range of motion was relatively consistent. After 6 weeks of intervention, the mean shoulder abduction increased significantly to 129.7°, ranging from 120° to 140°. The standard deviation of 5.24° shows some variability among participants but overall reflects a consistent improvement across the group.

The paired t-test revealed a t-value of 22.61 with a p-value of 0.000 ($p < .001$), indicating that the improvement in shoulder abduction is statistically significant.

The graph clearly illustrates this change, showing a marked increase in mean shoulder abduction from pre-treatment to post-treatment, confirming that participants had substantial improvement in shoulder mobility over the 6-week intervention.

Table 2: SPADI

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	F (t)	Sig. (p-value)
Pre (0 week)	30	61	73	67.3	3.55		
Post (6 week)	30	35	48	42.8	3.62	24.47*	0.000 (p < .001)
Overall	60	35	73	55.05	12.96		

Graph2: SPADI

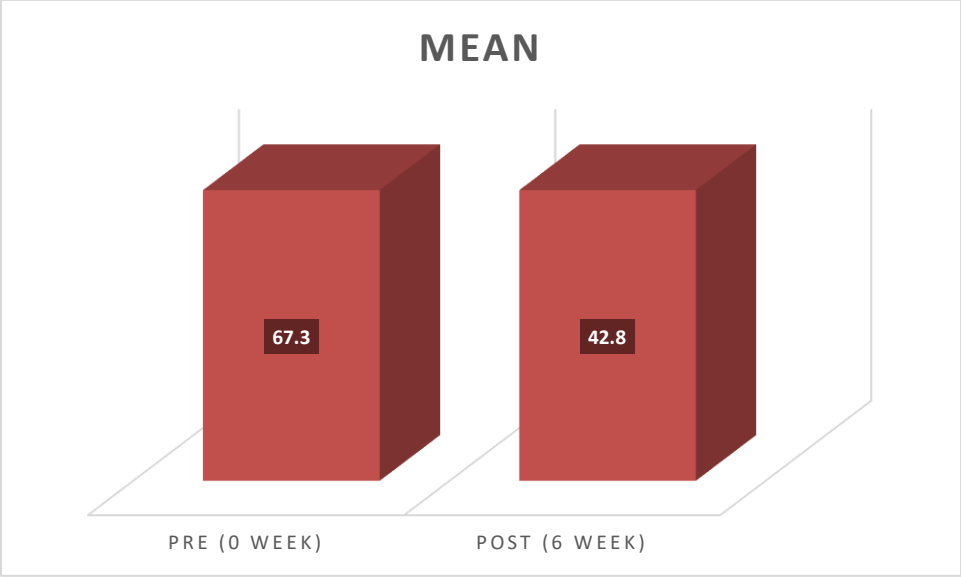

Table 2 and Graph 2 present the SPADI scores (pain and disability index) for participants at baseline and after 6 weeks of intervention. At pre-treatment (0 week), the mean SPADI score was 67.3, with scores ranging from 61 to 73, and a standard deviation of 3.55, showing that participants had relatively similar levels of shoulder pain and disability at the start.

After 6 weeks, the mean SPADI score decreased to 42.8, with a minimum of 35 and a maximum of 48, and a standard deviation of 3.62. This reduction in scores indicates a significant improvement in shoulder pain and functional ability. The paired t-test shows a t-value of 24.47 with a p-value of 0.000 ($p < .001$), confirming that the improvement in SPADI scores is statistically significant. The graph visually demonstrates a clear drop in SPADI scores from pre-treatment to post-treatment, highlighting that participants experienced substantial reduction in shoulder pain and disability after the intervention.

DISCUSSION

The present study was design to examine the effects of manual therapy, combined with exercise, in individuals affected with subacromial impingement syndrome. A total of 30 patients were included and assessed using pre- and post-intervention outcome measures. The outcome measures used were the Shoulder Pain and Disability Index (SPADI) and range of motion measured with a goniometer. The findings suggest a significant reduction in pain level and improvement in range of motion and functional abilities following the intervention. These data suggest that the application of Manual therapy with specified exercises is effective intervention for treating subacromial impingement syndrome.

When the findings of the present study are compared with the existing literature, it is evident that both treatment procedures are consistent with and strongly support the findings reported in previous studies. A recent systematic review by Singh H et al. (2022) on the management of Subacromial Impingement Syndrome reported that scapular exercises, resistance exercises, and myofascial trigger point release techniques are effective in reducing pain and improving functional ability. These findings are consistent with the results of the present study and further support our outcomes.

As observed, Subacromial Impingement Syndrome is a common condition affecting individuals across young, middle-aged, and older populations. Several factors may contribute to the development of this condition, including both pathological and traumatic causes. However, one of the major contributing factors is soft-tissue imbalance, postural insufficiency, and Scapular Dyskinesia. Considering these contributing factors, the present study was conducted to address these impairments. After

implementing a 6-week treatment program, the results indicated that exercise combined with manual therapy led to improvements in range of motion and functional ability.

CONCLUSION

The findings of the study showed that exercise combined with manual therapy programmes is statistically significant improvements over a 6-week intervention period in terms of improvements in range of motion and functional ability. The findings and results of the present study are clinically important for physiotherapists involved in musculoskeletal and orthopedic rehabilitation, as well as for rehabilitation professionals and rehabilitation specialists. The use of exercise combined with manual therapy programmes may contribute to improving treatment strategies in the field of shoulder rehabilitation. The results of this study can be applied clinically to assist healthcare professionals in the better management. However, further studies with a larger sample size and more rigorous inclusion and exclusion criteria are required to validate and generalize these findings.

REFERENCE

1. Ucurum SG, Kaya DO, Kayali Y, Askin A, Tekindal MA. Comparison of different electrotherapy methods and exercise therapy in shoulder impingement syndrome: A prospective randomized controlled trial. Acta orthopaedica et traumatologica turcica. 2018 Jul 1;52(4):249-55.
2. Aggarwal K. Effect of kinetic chain activation technique in shoulder impairment: A review.
3. Panagiotopoulos AC, Crowther IM. Scapular Dyskinesia, the forgotten culprit of shoulder pain and how to rehabilitate. SICOT-J. 2019 Aug 20;5:29.
4. Pinkas D, Wiater JM. Functional anatomy of the shoulder?. Orthopaedic Physical Therapy Secrets-E-Book. 2016 Sep 10;318.
5. Ginn K, Green R, Richardson E, Gagey O. Shoulder anatomy and function. Shoulder: Theory Pract. 2022 Mar 21;31.
6. Singh H, Thind A, Mohamed NS. Subacromial impingement syndrome: a systematic review of existing treatment modalities to newer proprioceptive-based strategies. Cureus. 2022 Aug 25;14(8).
7. Sharma SA, Hussain ME, Sharma SH. Manual therapy combined with therapeutic exercise vs therapeutic

exercise alone for shoulder impingement syndrome: A systematic review and meta-analysis. J Clin Diagn Res. 2021 Apr 1;15(4):10-7.

8. Horowitz EH, Aibinder WR. Shoulder impingement syndrome. Physical Medicine and Rehabilitation Clinics. 2023 May 1;34(2):311-34.
9. Consigliere P, Haddo O, Levy O, Sforza G. Subacromial impingement syndrome: management challenges. Orthopedic research and reviews. 2018 Oct 23:83-91.
10. Bishop MD, Torres-Cueco R, Gay CW, Lluch-Girbés E, Beneciuk JM, Bialosky JE. What effect can manual therapy have on a patient's pain experience?. Pain management. 2015 Nov 1;5(6):455-64.
11. Pekyavas NO, Baltaci G. Short-term effects of high-intensity laser therapy, manual therapy, and Kinesio taping in patients with subacromial impingement syndrome. Lasers in medical science. 2016 Aug;31(6):1133-41.
12. Azin Z, Kamali F, Dehno NS, Abolahrari-Shirazi S. Comparison of manual therapy technique to therapeutic exercise in the treatment of patients with subacromial impingement syndrome: a randomized clinical trial. Journal of manipulative and physiological therapeutics. 2023 Feb 1;46(2):98-108.
13. Aslanov N, Ersin A. Comparison of the effects of manual therapy and scapular stabilization exercises on pain, functional status, and quality of life in subacromial impingement syndrome. Journal of Health Sciences and Medicine. 2023 Oct 19;6(6):1373-9.
14. Lv Y, Yin Y. A review of the application of myofascial release therapy in the treatment of diseases. Journal of Multidisciplinary Healthcare. 2024 Dec 31:4507-17.
15. Li Y, Li X, Song H, Shou Y, Fang Q. Health-related outcomes with supervised exercise and myofascial release versus only supervised exercise in subacromial pain syndrome: a randomized controlled single-blind study. BMC Sports Science, Medicine and Rehabilitation. 2024 Aug 13;16(1):171.
16. Maktedar D, Nagulkar D, Shinde D, Mahajan D, Jitendra D. M. Immediate Effect of Myofascial Release Along with Muscle Energy Technique on Range of Motion and Pain in Patients with Shoulder Impingement Syndrome-An Experimental Study. Int J Heal Sci Res. 2023;13:268-76.
17. Gutiérrez-Espinoza H, Cuyul-Vásquez I, Olguin-Huerta C, Baldeón-Villavicencio

M, Araya-Quintanilla F. Effectiveness of glenohumeral joint mobilization on range of motion and pain in patients with rotator cuff disorders: a systematic review and meta-analysis. Journal of Manipulative and Physiological Therapeutics. 2023 Feb 1;46(2):109-24.

18. Kim Y, Lee G. Immediate effects of angular joint mobilization (a new concept of joint mobilization) on pain, range of motion, and disability in a patient with shoulder adhesive capsulitis: a case report. The American journal of case reports. 2017 Feb 10;18:148.
19. Dias D, Neto MG, Sales SD, Cavalcante BD, Torrierri Jr P, Roever L, Araujo RP. Effect of mobilization with movement on pain, disability, and range of motion in patients with shoulder pain and movement impairment: a systematic review and meta-analysis. Journal of Clinical Medicine. 2023 Nov 29;12(23):7416.
20. Eliason A, Harringe M, Engström B, Werner S. Guided exercises with or without joint mobilization or no treatment in patients with subacromial pain syndrome: a clinical trial. Journal of Rehabilitation Medicine. 2021 Feb 26;53(5):2765.
21. Lluch E, Pecos-Martín D, Domenech-García V, Herrero P, Gallego-Izquierdo T. Effects of an anteroposterior mobilization of the glenohumeral joint in overhead athletes with chronic shoulder pain: a randomized controlled trial. Musculoskeletal Science and Practice. 2018 Dec 1;38:91-8.
22. Venturin D, Giannotta G, Pellicciari L, Rossi A, Pennella D, Goffredo M, Poser A. Reliability and validity of the Shoulder Pain and Disability Index in a sample of patients with frozen shoulder. BMC Musculoskeletal Disorders. 2023 Mar 22;24(1):212.
23. Brindisino F, Indaco T, Giovannico G, Ristori D, Maistrello L, Turolla A. Shoulder Pain and Disability Index: Italian cross-cultural validation in patients with non-specific shoulder pain. Shoulder & Elbow. 2021 Aug;13(4):433-44.
24. van Rijn SF, Zwerus EL, Koenraadt KL, Jacobs WC, van den Bekerom MP, Eygendaal D. The reliability and validity of goniometric elbow measurements in adults: A systematic review of the literature. Shoulder & elbow. 2018 Oct;10(4):274-84.
25. Acar S, Aljumaa H, Şevik K, Karatosun V, Ünver B. The intrarater and interrater reliability and validity of universal

goniometer, digital inclinometer, and smartphone application measuring range of motion in patients with total knee arthroplasty. Indian Journal of Orthopaedics. 2024 Jun;58(6):732-9.

26. Hecker A, Aguirre J, Eichenberger U, Rosner J, Schubert M, Sutter R, Wieser K, Bouaicha S. Deltoid muscle contribution to shoulder flexion and abduction strength: an experimental approach. Journal of shoulder and elbow surgery. 2021 Feb 1;30(2):e60-8.
27. Stokey PJ, Kaur S, Lee A, Behrens K, Ebraheim N. Anatomy and deficiency of the deltoid muscle: a review of literature. Orthopedic Reviews. 2024 Mar 30;16:115352.
28. Palmer E, Matlick D, Council RO, Richman S. Hot packs. Cinahl Inf Syst. 2021 Jan 1.
29. Park SJ, Kim SH, Kim SH. Effects of thoracic mobilization and extension exercise on thoracic alignment and shoulder function in patients with subacromial impingement syndrome: A randomized controlled pilot study. InHealthcare 2020 Sep 2 (Vol. 8, No. 3, p. 316). MDPI.
30. ARORA A, KHAN J, ANAMALAI KM, VYAS K. A COMPARATIVE STUDY BETWEEN DRY NEEDLING AND KINETIC CHAIN ACTIVATION TECHNIQUE WITH SPECIFIED EXERCISE PROGRAMME IN PAINFUL ARC SYNDROME. Int J Curr Pharm Sci [Internet]. 2024 Nov. 15 [cited 2026 Mar. 14];16(6):17-20. Available from: https://journals.innovareacademics.in/index.php/ijcpr/article/view/53052
31. Dr. Abhishek Arora, Dr. Jafar Khan, Dr. KM Anamalai and Dr. Renuka Pal. A randomized control trial: Role of k-cat technique with a specific exercise program in treating painful arc syndrome. Int. J. Pharm. Clin. Res. 2024;6(2):41-44.
DOI: 10.33545/26647591.2024.v6.i2a.100