



# Effects of Maitland Mobilization Techniques with and without Kinesio Taping in Patient with Shoulder Sub-acute Adhesive Capsulitis

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## Abstract

**Objective:** To compare the effects of Maitland mobilization techniques with and without Kinesio Taping in patient with shoulder sub-acute adhesive capsulitis.

**Method:** Twenty-six patients with sub-acute adhesive capsulitis participated and were randomly divided into two groups. Group A (N = 13) received Kinesio tape along with Maitland mobilization and supervised exercise, while Group B (N = 13) received Maitland mobilization and exercise under supervision. The visual analogue scale (VAS), range of motion (ROM), shoulder pain and disability index score (SPADI), and flexion and extension momentum were measured before and after each intervention. The patients were treated thrice a week for the 10 sessions and then re-assessed for all the outcomes.

**Results:** All two intervention groups showed decreases in pain (P = 0.000) and SPADI score (P = 0.00), as well as increases in all ranges of motion (flexion, abduction, external rotation, and internal rotation) (P = 0.000). No significant differences were found between the two groups in VAS, SPADI, and ROM (P > 0.05) except in flexion momentum, which was better in Group B.

**Conclusion:** Results of this study indicated that all two-interventions used in this study were effective in the treatment of sub-acute adhesive capsulitis. However, this study concludes that the Maitland mobilization group is enough for the management of sub-acute adhesive capsulitis.

**Keywords:** Adhesive capsulitis, Maitland mobilization, Kinesio tape, Exercise, Diabetes mellitus, SPADI

DOI Number: 10.48047/NQ.2022.20.21.NQ99056

Neuro Quantology 2022; 20(21): 473-483



## Introduction

Adhesive capsulitis (AC) is a condition that limits active and passive range of motion in the glenohumeral joint, causing pain and loss of motion. The entire upper extremity suffers as a result of discomfort, stiffness, and reduced function at the glenohumeral joint. Patients often complain of shoulder discomfort and limited joint motion. The most common range of motion limitations is flexion, abduction, external and internal rotation [1, 2]. Patients with AC frequently struggle with grooming, carrying out daily duties, clothing, and, notably, fastening objects behind their backs. In the general population, annual incidences range from 3% to 5%, and in those with diabetes, they can even reach 40% [3]. Women are more frequently afflicted than men, and it primarily affects adults between the ages of 40 and 60 [3, 4]. The two basic categories of AC are the acquired or secondary form and the idiopathic or primary form [5]. Maitland mobilization (MM) is a manual technique commonly used in order to decrease pain and stiffness in the shoulder joint [6, 7]. Another set of suggestions supported Maitland's rhythmic oscillations' ability to reduce inflammation. Continuous circulatory stasis can cause ischemia as well as oedema, inflammation, and fibrosis in the brain [8]. There are several studies that have been provided that show the positive effect of the Maitland mobilization in the management of adhesive capsulitis [9, 10]. A non-invasive method of treating musculoskeletal ailments is kinesio taping (KT). The suppleness of Kinesio Tape resembles and enhances the performance of muscle fibers and tendons. Kinesio tape can reduce fascial contraction during soft tissue injury and help reorganize the fascia during chronic injury. The Kinesio Taping approach is based on the straightforward notion that the body has built-in healing mechanisms that healthcare professionals can help improve by removing obstructions to their effectiveness [11]. When you move, kinesio tape's expanding and contracting qualities gently stimulate different kinds of skin-based sensory receptors. Through stimulation of touch receptors, this activates the spinal inhibitory system and, via the Gate Control Theory, also the descending inhibitory system, which both work to reduce pain [10]. Also, there was a study that proved the positive effect of Kinesio tape along with end-

range mobilization (ERM) in the management of adhesive capsulitis of the shoulder joint [12].

Several studies about the efficacy of Kinesio taping and Maitland mobilization have been published. In fact, these articles have a number of flaws: first, they can't discuss the dose (the progressive Maitland dose) or the angle of osteokinematics at which they decided to apply gliding; second, those who really don't get to choose specific exercises as the main part of the protocol; third, they only used two or one strip of tape, while the previous article suggested utilizing four strips of tape at the same time; thereby, this study will be much more exhaustive than earlier studies with this concept.

## Materials and Methods

A randomized controlled trial (RCT) was designed for the treatment of patients with shoulder subacute adhesive capsulitis. The Ethics Committee of the Tehran University of Medical Sciences (TUMS) approved this study (IR.TUMS.FNM.REC.1401.037), and the IRCT code was (IRCT20210214050356N4). All of the participants (N = 26) were recruited according to the inclusion and exclusion criteria. Age between 40-60 years, primary type of adhesive capsulitis, sub-acute stage of adhesive capsulitis, patients with muscle strength of no less than grade 3, and people with a capsular pattern of motion limitation were inclusion criteria for the current study. Exclusion criteria were involved history of shoulder dislocation, shoulder fractures (in past 1 year), concomitant cervical spine symptoms, past shoulder surgery, history of neurological condition (e.g.: stroke, parkinsonism), individuals with hypersensitivity to tape, individuals with uncontrolled diabetes, supraspinatus tendon rupture, major cardiopulmonary problems [13].

**Study design:** The study was a single-blind, randomized clinical trial. The patients were divided randomly into two groups. Group A (N=13) received Maitland mobilization along with Kinesio tape, and group B (N=13) received Maitland mobilization only; both groups also received exercise under supervision. All patients were recruited for this study after a specialist in orthopedics, or a rheumatologist diagnosed them with sub-acute adhesive capsulitis. All of the participants (13 females and 13 males) were



checked for the inclusion and exclusion criteria and received 10 sessions of intervention, averaging 3 sessions per week. Before starting the dealing protocol, written consent was clarified and signed by the selected patients to declare their permission. Prior to the start of treatment involvement, all advantages and potential disadvantages are clearly explained to patients in the written consent form. In addition, the patients were instructed to avoid other treatments or medications at home.

**Method of assignment to study groups:** The patients were randomly assigned to the Kinesio tape along with the Maitland group or only the Maitland group. Randomization was done using twenty-six cards inside a ball. The patients were asked to come and choose a card. Number one was Group A, and number two was Group B.

### Assessment

Pain intensity at rest and during activity (VAS), range of motion (ROM), the shoulder pain and disability index score (SPADI) questionnaire, and muscle momentum in flexion and extension were measured before and after the treatment in each group.

**Visual analog scale (VAS) pain scale:** The VAS is a 100-mm horizontal line with polar descriptors of no pain and the worst pain possible. Participants specified their pain by placing a vertical line at the point that represented their current level of symptoms [14].

**Shoulder pain and disability index questionnaire (SPADI) Arabic version [15]:** The SPADI is divided into two subscales: five items for pain and eight items for disability conditions; the combined score of the two subscales ranges from 0 to 130, with higher scores indicating greater levels of pain and disability.

**Shoulder range of motion (ROM) [16]:** The active shoulder range of motion was measured using photogrammetry with patients in the supine position. For flexion, a cross was inserted on the lateral aspect of the humeral head's center, just below the acromion process. Two cross marks were positioned: one along the midline of the thorax and two along the mid-shaft of the humerus both aligned with the larger tuberosity and lateral epicondyle of the humerus. The thumb was pointing upward, and the arm was aggressively raised in a precise

sagittal plane. For abduction, a cross was placed on the coracoid process. A cross mark was made along the humerus' shaft, and a second cross mark was made along the thorax's midline. The thumb was pointing upward, and the arm was aggressively raised in the strict coronal plane. For external rotation, two cross marks were made: one at the ulnar styloid process and one at the olecranon process (fulcrum). The elbow was bent to 90 degrees, the wrist was neutral, and the tested arm was positioned on the table at a 90° abduction. A weighted bag was utilized to stop unwanted scapular motions, and a towel roll was placed beneath the humerus. The individual was then requested to rotate their arm back into their available end range. During this assessment, the individual was asked not to elevate their lower back. For internal rotation, the identical steps as for external rotation were employed, except the participant was told to internally rotate their arm while keeping it 90 degrees abducted.

**Shoulder muscle momentum (flexion and extension):** Patients were asked to sit on the chair (armless), and the patient's back was fixed with a belt using a standard camera and Kinovea software. A cross mark was placed just below the acromion process on the lateral face of the humeral head's center (fulcrum), one cross mark was placed along the participants' thorax's midline, and two more cross marks were inserted along the humerus' mid-shaft, aligned with the greater tuberosity and lateral epicondyle. They were instructed to move their arms in a circular motion in both the flexion and extension directions. We took a video with the Nikon (standard) camera to measure joint angle and imported the video to the Kinovea software (version 0.8.15; <http://www.kinovea.org/>) by exporting data to an Excel file that we wrote the formula on for analysis. All the data was exported to the motion analysis software MTA470 for interpretation.

### Intervention

#### Maitland Mobilization

For **caudal glide**, the patient was in a supine position with the arm abducted and externally rotated to the end range. In a standing or sitting position, the therapist held the proximal end of the humerus and maintained a lateral humeral

distraction in its mid-range position. For **anterior glide**, the patient was made to lie in a prone position, and at the end of the range of abduction and external rotation, lateral humeral distraction was given, and stretch mobilizations were performed by utilizing the subject's body weight and gravity to generate the mobilizing force. For **posterior glide**, the patient was made to lie in a supine position, and at the end of the range of internal rotation and adduction, lateral humeral distraction was given, and stretch mobilizations were performed by utilizing the subject's body weight and gravity to generate the mobilizing force. The glides were administered at a rate of 2-3 glides per second for 30 seconds per glide, and each glide was administered for 5 sets to improve external rotation. The technique was applied three times a week for 10 sessions<sup>[17]</sup>.

### Kinesio taping

Used a strip of 4 KT (Careous, Chinese tape). KT with an I stripe over the supraspinatus was first administered after the patient was asked to adduct, extend, and internally rotate the shoulder while doing contralateral neck flexion. The anchor was then attached below the greater tuberosity without tension. Along the scapula's spin, the remaining tape strip was placed, and it ended without stress. Deltoid receives a second KT (Y-strip). The first tail of the anchor was applied to the anterior deltoid when the arm was externally rotated and abducted horizontally. The arm was in horizontal adduction and internal rotation as the second tail was applied to the posterior deltoid. Both tails end up with no tension. The third KT (I-strip) for the teres minor muscle should be placed loosely on the lower facet of the larger tuberosity. The patient was instructed to flex the arm, abduct it horizontally, and internally rotate it. At the inferior angle of the scapula, the end of the tape was attached without stretching. The mechanical correction approach was used to apply the fourth KT strip, which made up the second KT application, at 50% to 75% tension. At the location of the shoulder's reported soreness, an I-strip (cut down the middle) was applied from the coracoid process anterior to

the posterior deltoid with downward pressure by the tape <sup>[11]</sup> (Figure 1).

### Exercises

According to the daily adjustable progressive resisted exercise (D.A.P.R.E.) workouts for strengthening the shoulders and scapulae were performed with weight cuffs <sup>[13]</sup>.

- The program's foundation is 6 RM (repetition maximum).
- Regimen entails 4 lifting bouts of each exercise per session subsequent increase are determined by number of repetition performed in set 3.

### Perform

- Set 1 = 10 reps at 50% 6 RM
- Set 2= 6 reps at 75% 6 RM
- Set 3 = as many as possible with full 6RM
- Set 4: as many repetitions as you can with a weight that has been adjusted (this weight is determined by the number of repetitions finished with the full working weight in set 3).
- The following table, the adjusted working weight for the fourth set is calculated based on the quantity of repetitions completed during the third set.

Number of repetition during set 3	For set 4
0-2	Decrease by 2.5-4.5 kg.
3-4	Decrease by 0-2.5 kg.
5-7	Keep weight same
8-12	Increase by 2.5-4.5 kg.
13+	Increase by 4.5-6.8 kg.

**Statistical analysis:** All statistical analysis was conducted using SPSS statistical software, version 23. The Kolmogorov-Smirnov (K-S) test was used to assess the normality of the data. A paired t-test was used to compare the before-after values of the variables. To compare the differences between the groups, an independent t-test was used. For all statistical tests, the P value was set at 0.05.





## Results:

Twenty-six patients, 13 males and 13 females, participated in the present study. The K-S Test of both groups shows a normal distribution of (VAS, SPADI score, ROM, and flexion and extension momentum) (P value > 0.05).

According to Table 1, the results of the independent sample T-test showed that there were no significant differences between the two groups in regard to demographic data (P > 0.05).

According to the results of the paired T-test, both groups had significant differences (before and after intervention) for the VAS, SPADI score, and ROM (P = 0.00). Also, the results of the flexion momentum in group B were significant (P=0.015). Furthermore, no significant differences in extension momentum were observed in either group (P > 0.05) (Table 2).

According to Table 3, there was no significant difference between the two groups in regards to the VAS (P = 0.848), SPADI score (P = 0.952), ROM (P>0.05), and extension momentum (P>0.312) except for the flexion momentum, which was significant (P = 0.015) and outperformed Group A.

## Discussion

In this study, the VAS, ROM, SPADI, and flexion and extension momentum before and after 10 sessions of interventions (3session / wks.) were compared between two groups: the Kinesio Tape and Maitland Mobilization (KT+MM) group (Group A), and the MM alone group (Group B). Both groups received exercise under supervision. Noticeable clinical improvements were evident by the reduction in pain scores in both groups, and this is in agreement with a previous study suggesting that mobilization reduces pain [18] due to neurophysiologic effects on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors [19, 20]. Many studies have claimed that an exercise program is the most effective treatment for shoulder adhesive capsulitis [21]. Exercises within the pain free range of motion stimulate mechanoreceptors and decrease pain. Exercises within a pain-free range also move the synovial fluid, thus decreasing inflammation and decreasing pain [22, 23].

**ROM.** Shoulder ROM improved significantly in both groups. Several authors have previously reported improvement of shoulder ROM accompanied by a reduction in pain intensity with KT application along with Maitland mobilization [21, 22].

**SPADI scores.** Both groups have shown statistically significant differences in shoulder pain and disability index score (SPADI), proving the improvement in shoulder function in both groups after having undergone intervention. This result correlates with previous studies [23, 24] which studied the effects of Maitland's end range mobilization (ERM) and exercises on subjects with adhesive capsulitis and found that besides pain and ROM, function also improved.

**Muscle momentum.** Flexion momentum showed statistically significant improvement only in the Maitland mobilization group (group B), proving the effect of the mobilization in improving shoulder strength for patients with subacute adhesive capsulitis. Besides pain, ROM and momentum also improved.

Several reasons may account for pain reduction through the Maitland mobilization. One of these possible reasons is the neurophysiological effects of stimulating type II mechanoreceptors while inhibiting type IV nociceptors. It also provokes Golgi tendon organ activity at the end of joint mobilization and causes reflex inhibition of muscle [6, 7] Another possible mechanism is that Maitland's rhythmic oscillations also have an effect on circulatory perfusion [25] and there are some reasons for the efficacy of KT application: the Gate Control Theory is the first, it is thought that the KT tape stimulates the neuromuscular system by increasing afferent feedback. According to the Gate Control Theory, a larger afferent stimulus can reduce the input received by small-diameter nerve fibers that carry pain sensation [26].

The current study showed that both groups had no significant effect in terms of improvements in pain intensity, disability scores, ROM, and extension momentum together except in flexion momentum (Table 3).

Stasinopoulos and Johnson (2004) stated that the suggested treatment plan for supervised exercise should involve exercise at least three times per week for four weeks as well as exercise at home for at least three months [27].

Shanmugam et al. (2014) compared the effect of Maitland mobilization with and without Kinesio tape intervention for individuals with frozen shoulder and found that VAS, SPADI score, and ROM improved significantly in both groups after 4 weeks and 10 sessions of treatment, similar to our findings [10]. The results showed that KT plus Maitland mobilization (MM) showed better improvement than MM alone.

Kumar et al. (2012) compared the effect of MM+exercise (EX) with EX alone and found that the addition of the Maitland mobilization technique to the combination of EXs has proven its efficacy in relieving pain and improving ROM and shoulder function. This study supports the effect of exercise for patients with idiopathic shoulder capsulitis, similar to our findings that showed significantly improved outcomes in both groups [28].

Mulmulay et al. (2018) compared the effects of Kaltenborn mobilization with and without Kinesio tape under exercise supervision for sub-acute adhesive capsulitis in relieving pain, improving ROM, and functional disability (SPADI) and demonstrated significant improvements in pain intensity, range of motion, and shoulder function in both groups. The results showed that the outcome measures were not significantly different between the two groups. It showed better improvement with adjunct KT and Kaltenborn mobilization for the management of adhesive capsulitis than Kaltenborn mobilization [13]. The current study didn't show any superiority between the two groups.

There was a systematic review done by Lu et al. (2016), that proved the effect of exercise and showed that exercises within the pain free range of motion stimulate mechanoreceptors and decrease pain. Exercises within a pain-free range also move the synovial fluid, thus decreasing inflammation and decreasing pain [29].

After analysis, the results of this study indicated that the Maitland mobilization technique combined with a supervised exercise protocol is effective and cost-efficient for treating idiopathic shoulder adhesive capsulitis. Both groups showed significant improvements in pain intensity (VAS), all ROM, and the SPADI score in Group B. These findings strongly support the findings of previous studies [28, 30], which

investigated shoulder motion, pain, and function using mobilization and exercises on a single case design and concluded that all four movements improved, though more gain in motion was observed when mobilizations were added. On the other hand, Smita Kanse et al. claimed that kinesiotaping is superior to conventional therapy and mobilization in terms of relieving pain, improving range of motion, and reducing impairment in patients with adhesive capsulitis [31]. The current study showed that there was no need to add kinesio tape to the Maitland mobilization group. In addition, the current study also showed a significant improvement in the flexion momentum in Group B as well, although there are no studies to confirm that.

Some limitations of this study should be known. First, the sample size is small. Second, after the tenth session, the effect of intervention techniques was not assessed. Third, the previous history of adhesive capsulitis of the shoulder was not taken into consideration.

### Clinical implication

In terms of flexion momentum, the current study concludes that the Maitland group is more effective for the management of subacute adhesive capsulitis.

### Conclusion:

According to the present study, all two treatment groups (Kinesio tape along with Maitland mobilization and exercises group and Maitland mobilization and exercises under supervision group) received suitable management for shoulder sub-acute adhesive capsulitis patients. Both groups showed significant improvement (decreased pain intensity) in VAS during activity, a decline in shoulder pain and function (SPADI score), increments in all motion planes (flexion, abduction, external rotation, and internal rotation), and the flexion momentum after 10 sessions of treatment in patients with sub-acute adhesive capsulitis. Only the MM group (Group B) showed significant differences in flexion momentum. So, Maitland mobilization alone under supervised exercise is suggested as a more effective, cost-effective, and appropriate manner of treatment for these patients.



**Ethical Considerations:**

**Compliance with ethical guidelines**

The Ethics Committee of Tehran University of Medical Sciences approved the protocol of the study (IR.TUMS.FNM.REC.1401.037), and the IRCT code was: (IRCT20210214050356N4).

**Funding**

This study was supported and accepted by the Tehran University of Medical Sciences (TUMS).

**Authors' contributions**

Conceptualization, study design: Mohammed Hayder Alkhozah neamah, Dr. Azadeh Shadmehr; Data analysis: Mohammed Hayder Alkhozah neamah, Dr. Sara Fereydounnia; Interpretation of data: Dr. Saeed Talebian , Isam Ali Hameedi ,Mohammed Hayder Alkhozah neamah; Writing the original draft: All authors; Writing-review, editing: All authors.

**Conflict of interest**

The authors declared no conflict of interest.

**Acknowledgement:**

The present study is a part of the MSc. thesis of the first authors supported by Tehran University of Medical Sciences. (Grant # 1401-3-103-62411).

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**Table 1:**Demographic characteristics for the Kinesio tape and Maitland mobilization( Group A) and Maitland mobilization alone( Group B) (n = 13 in each group).

Variables	Mean ±SD		Sig. tailed)	ζ t	Effect size	481
	Group A	Group B				
Gender						
(Male /Female)	7/6	6/7				
Age (year)	51.92±6.86	54.07±6.18	.409	.841	.32	
Height(cm)	163.53±7.6	163.69±8.88	.963	.047	.02	
Weight(kg)	81.47±17.38	82.12±18.34	.927	.092	.03	
BMI (k/m^2)	30.35±5.63	30.49±6.21	.953	.059	.02	

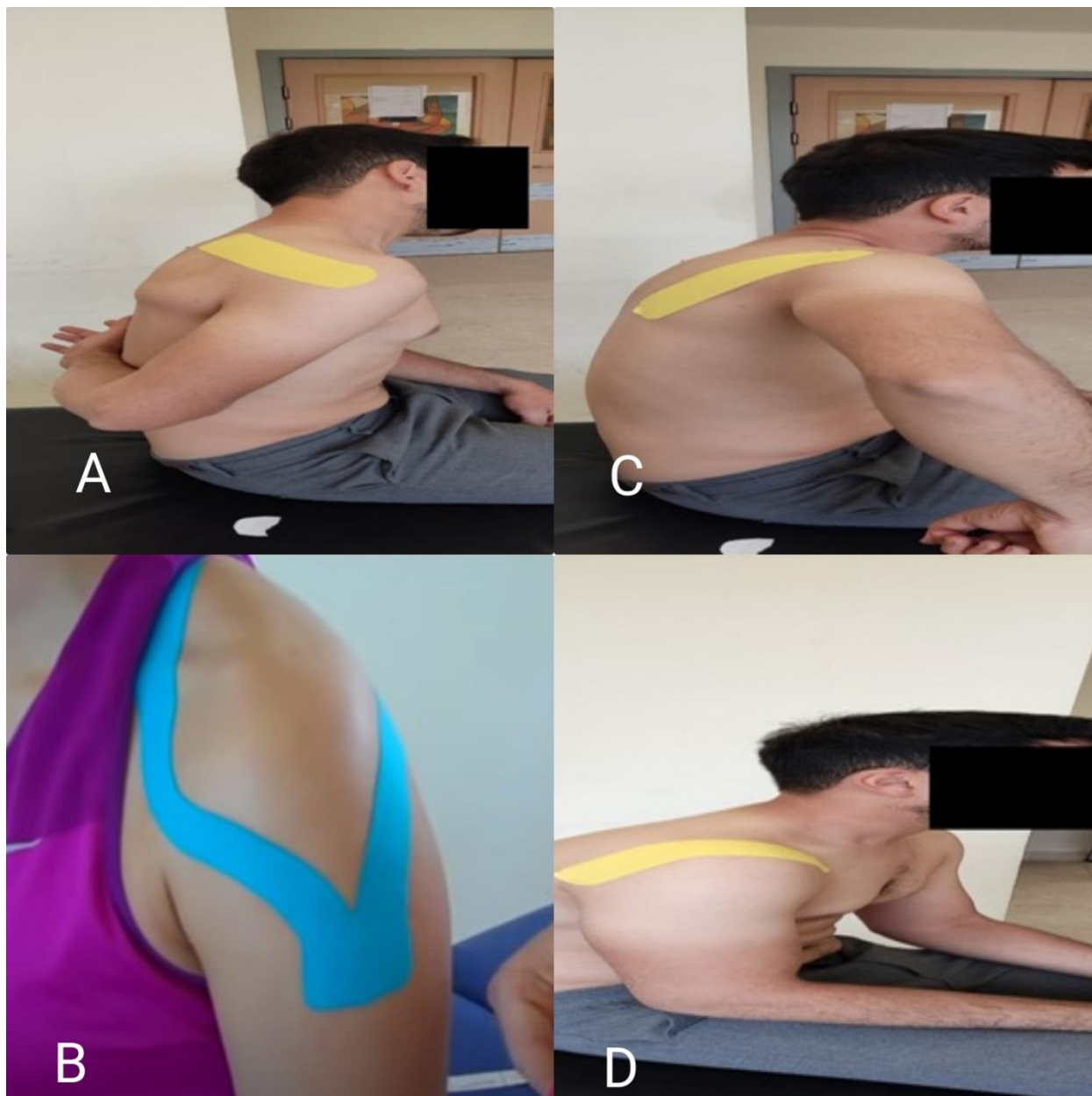
**Table 2:** The results and statistical comparisons of the pre-treatment and post-intervention values of (VAS, SPADI score, ROM, and momentum) within the Kinesio tape and Maitland mobilization (Group A) and Maitland mobilization alone (Group B) (n = 13 in each group).

Variables		Mean ±SD		Mean difference	95% Confidence Interval of the Difference		t	Sig. (2-tailed)
		Before intervention	After intervention		Lower	upper		
VAS (mm)	Group A	80±17.79513	4.61±11.26	-75.38±21.06	-88.11	-62.65	-12.905	.000
	Group B	75.38±18.98	1.53±5.54	-73.84±19.38	-85.55	-62.13	-13.73	.000
SPADI score	Group A	103.30 ±13	8±9.28	-95.30±13.57	-103.51	-87.10	-25.30	.000
	Group B	100.76±10.74	5.76±6.63	-95±12.28	-102.42	-87.57	-27.89	.000
Flexion ROM (degree)	Group A	96.92±13.19	169.53±13.64	72.61±10.65	66.17	79.05	24.58	.000
	Group B	100.38±11.56	170.46±10.34	70.07±17.35	59.59	80.56	14.56	.000
Abduction ROM (degree)	Group A	68.15±9.92	112.69±16.20	44.53±13.66	36.28	52.79	11.75	.000
	Group B	62.84±17.42	107.61±16.34	44.76±17.82	33.99	55.54	9.05	.000
Internal Rotation ROM (degree)	Group A	16±14.76	61.61±23.75	45.61±20.59	33.17	58.05	7.98	.000
	Group B	21.30±13.53	63±15.56	41.69±15.10	32.56	50.82	9.95	.000
External Rotation ROM (degree)	Group A	21±11.81	70.30±17.39	49.30±16.07	39.59	59.02	11.05	.000
	Group B	18±17.28	70.92±21.26	52.92±20.15	40.74	65.10	9.46	.000
Extension Momentum (N*m)	Group A	-6.88±3.68	-7.29±3.52	-.41±3.08	-2.27	1.45	-.48	.638
	Group B	-8.42±4.75	-10.11±2.29	-1.68±3.21	-3.63	.25	-1.89	.083
Flexion Momentum (N*m)	Group A	11.34±5.68	8.65±7.33	-2.68±7.09	-6.96	1.60	-1.36	.198
	Group B	9.98±3.30	12.61±2.65	2.63±3.34	.60	4.65	2.83	.015



**Table 3:** Comparison of the mean improvement of (VAS, SPADI score, ROM, and momentum) between the Kinesio tape and Maitland mobilization (Group A) and Maitland mobilization alone (Group B) (n = 13 in each group).

Variables	Mean ±SD		Mean difference	95% Confidence Interval of the Difference		t	Sig. (2-tailed)	Power
	Group A	Group B		Lower	upper			
VAS improvement (mm)	-75.38±21.06	-73.84±19.38	-1.53	-17.92	14.84	-.194	.848	.054
SPADI score improvement	-95.30±13.57	-95±12.28	-.30	-10.78	10.17	-.061	.952	.050
Flexion ROM improvement (degree)	72.61±10.65	70.07±17.35	-2.53	-14.19	9.11	-.450	.657	.072
Abduction ROM improvement (degree)	44.53±13.66	44.76±17.82	.23	-12.62	13.08	.037	.971	.050
Internal Rotation ROM improvement (degree)	45.61±20.59	41.69±15.10	-3.92	-18.54	10.69	-.554	.585	.083
External Rotation ROM improvement (degree)	49.30±16.07	52.92±20.15	3.61	-11.14	18.37	.506	.618	.077
Extension Momentum improvement (N*m)	-.41±3.08	-1.68±3.21	-1.27	-3.82	1.27	-1.032	.312	.168
Flexion Momentum improvement (N*m)	-2.68±7.09	2.63±3.34	5.31	.82	9.80	2.83	.022	.649



**Figure 1: KT applications: A) for supraspinatus, B) for deltoid, C) for teres minor, D) for mechanical correction.**