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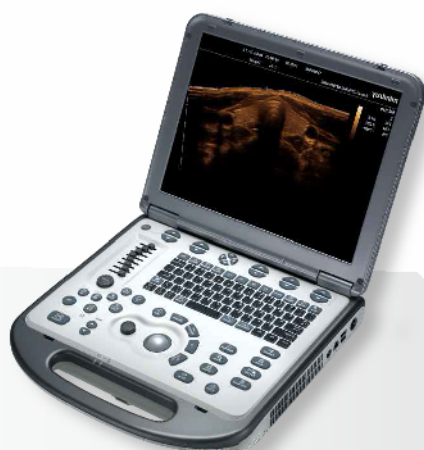
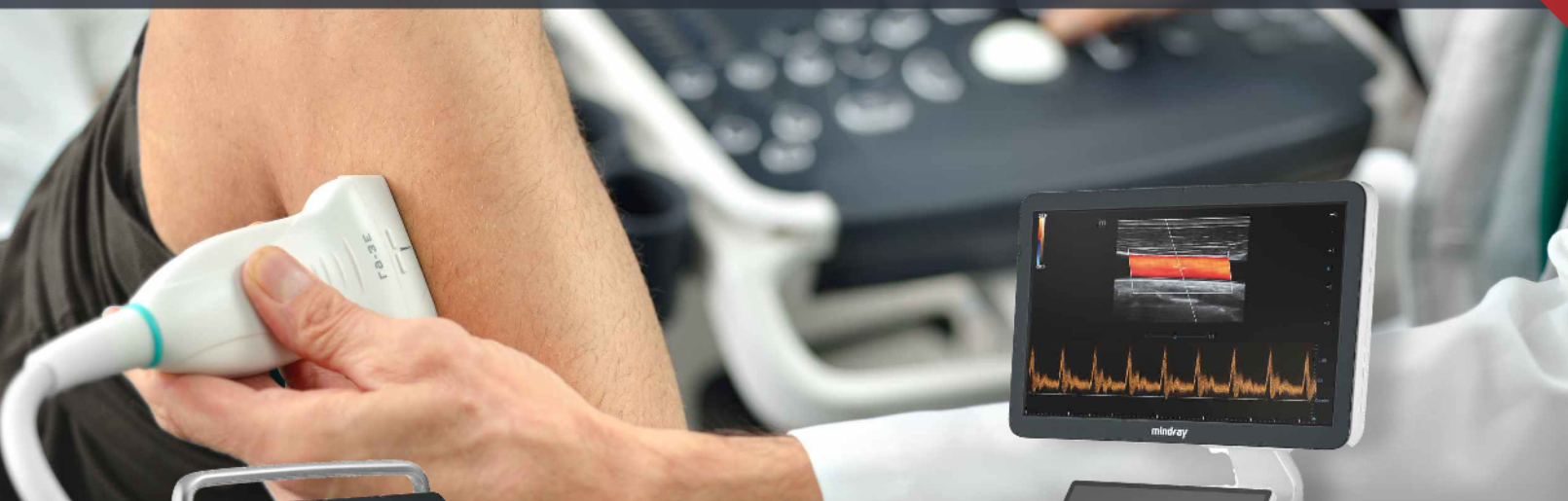
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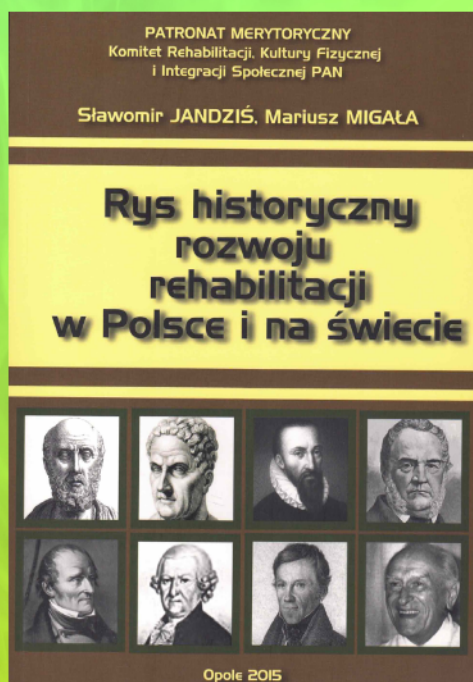
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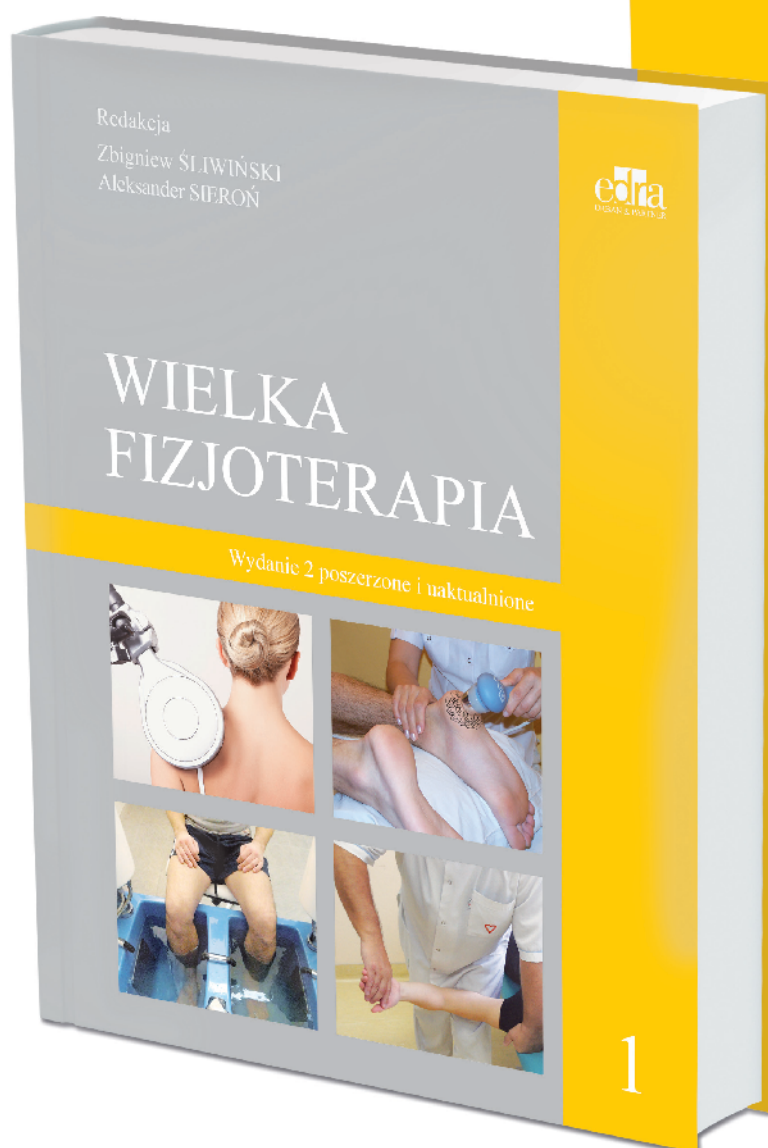
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# Carry over effect of different cervical mobilization techniques on shoulder muscle strength in rotator cuff tendinitis patients: A randomized control trial

*Efekt przeniesienia różnych technik mobilizacji szyjnej na siłę mięśni barku u pacjentów z zapaleniem ścięgien stożka rotatorów: randomizowane badanie kontrolne*

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## Abstract

**Objective.** To study if different cervical mobilizations have a long-term effect on pain relief and strengthening of external rotators and abductors in rotator cuff tendinitis. **Method.** Seventy-five patients with rotator cuff tendinitis were recruited from outpatient clinic, with age ranged from 25 to 40 years. Group A: C<sub>5-6</sub> antero-posterior cervical mobilization and ultrasound therapy. Group B: C<sub>5-6</sub> lateral glide cervical mobilization and Ultrasound. Group C: C<sub>5-6</sub> Postero-anterior cervical mobilization and US. The Visual Analogue Scale measured pain severity level and Lafayette Manual Muscle Tester measured shoulder external rotators and abductors isometric muscle strength. **Results.** The Wilcoxon test revealed a statistically significant difference in shoulder external rotators, abductors strength, and pain reduction between pre, immediate post-mobilization, 10 minutes post-mobilization, and 30 minutes post-mobilization within the three groups. But, the immediate post-mobilization and 10 minute post-mobilization median values of external rotators were statistically significant differences among the three groups, while the 30 minute post-mobilization median values of external rotators were not. For Abductors: Among the three groups, there were no statistically significant differences in abductors' immediate post-mobilization, 10 minute post-mobilization, or 30 minute post-mobilization, but there were statistically significant differences in pain scores immediate post-mobilization, 10 minute post-mobilization, and 30 minute post-mobilization. **Conclusion.** The study found that all three kinds of cervical mobilization are useful in reducing pain and strengthening the external rotators and abductors muscles and that the most effective method is antero-posterior in treating rotator cuff tendinitis.

## Key words:

lateral glide, antero-posterior mobilization, postero-anterior glide, muscle strength, rotator cuff tendinitis

## Streszczenie

**Cel.** Zbadanie, czy różne techniki mobilizacji szyjnej mają długotrwały wpływ na łagodzenie bólu i wzmacnianie zewnętrznych rotatorów i odwodźcicieli w zapaleniu ścięgien stożka rotatorów. **Metody.** Siedemdziesięciu pięciu pacjentów w wieku od 25 do 40 lat z zapaleniem ścięgna stożka rotatorów zostało zrekrutowanych z poradni do wzięcia udziału w badaniu. Grupa A: C<sub>5-6</sub> przednio-tylna mobilizacja szyjna i terapia ultradźwiękowa. Grupa B: C<sub>5-6</sub> boczna mobilizacja szyjna i terapia ultradźwiękowa. Grupa C: C<sub>5-6</sub> tylno-przednia mobilizacja szyjna i terapia ultradźwiękowa. Wizualna Skala Analogowa mierzyła poziom nasilenia bólu, a Ręczny Tester Siły Mięśni Lafayette mierzył izometryczną siłę mięśni zewnętrznych rotatorów i odwodźcicieli barku. **Wyniki.** Test Wilcoxona wykazał statystycznie istotną różnicę w zewnętrznych rotatorach barku, sile odwodźcicieli i redukcji bólu przed, bezpośrednio po mobilizacji, 10 minut po mobilizacji i 30 minut po mobilizacji w trzech grupach. Jednak w przypadku mediany wartości rotatorów zewnętrznych bezpośrednio po mobilizacji i 10 minut po mobilizacji zaobserwowano statystycznie istotne różnice między trzema grupami, podczas gdy w przypadku mediany wartości 30 minut po mobilizacji rotatorów zewnętrznych nie zaobserwowano żadnej różnicy. Odwodźciele: Wśród trzech grup nie zaobserwowano statystycznie istotnych różnic w wynikach bezpośrednio po mobilizacji, 10 minut po mobilizacji lub 30 minut po mobilizacji, ale zaobserwowano statystycznie istotne różnice w ocenie bólu bezpośrednio po mobilizacji, 10 minut po mobilizacji i 30 minut po mobilizacji. **Wniosek.** Badanie wykazało, że wszystkie trzy rodzaje mobilizacji szyjnej są przydatne w zmniejszaniu bólu i wzmacnianiu zewnętrznych mięśni rotatorów i odwodźcicieli, jednak najskuteczniejszą metodą jest przednio-tylna metoda leczenia zapalenia ścięgna stożka rotatorów.

## Słowa kluczowe

mobilizacja boczna, mobilizacja przednio-tylna, mobilizacja tylno-przednia, siła mięśni, zapalenie ścięgna rotatorów



## Introduction

Shoulder pain is a common clinical symptom, with rotator cuff disorders being the most common cause [1, 2, 3, 4]. The prevalence of shoulder pain/disorders has been previously recorded [2, 5, 6, 7], with estimates ranging from 7% to 26%, monthly (19% to 31%), annual (5% to 47%), and lifetime (7% to 67%) There were few assumptions about risk and prognostic factors [5, 6, 7]. The most prevalent causes of intrinsic shoulder discomfort are shoulder impairment syndrome (SIS) and rotator cuff tendinitis [8, 9]. Shoulder problems always connected with activities that includes raising shoulder over 60° in any plane [10, 11].

Anatomical acromion deficiencies, faulty posture, kinematic changes in scapula and humerus, changes in scapular muscle and rotator cuff muscles performance, and reduced pectoralis minor stretch capacity are all extrinsic variables that alter the sub-acromial region and are accountable for the RC tendonitis [12]. Because of the location of the supraspinatus tendon in sub-acromial space, so it is the most vulnerable structure. Through histological examinations, the degenerative changes that occur in the supraspinatus tendon have been seen in patients with impingement [13].

Physical therapy rehabilitation plays a crucial role in treatment of rotator cuff tendinitis. Restoring rotator cuff strength and normal motion range has been the main target for most treatment programs, besides reducing pain and improving endurance. Ultrasound, heat, and cold are among physical therapy methods that can help with pain management. Manual therapy may be used to help to regain normal range and function of the affected shoulder as it helps to reduce pain associated with movement [14, 15].

According to Madeleine et al. [16] neck pain affects muscle function in the shoulder and arm also Cyriax and Cyriax [17] have suggested that the reference pain that causes reduced shoulder joint mobility may originate in the neck. They further claimed that shoulder joint motion and cervical motion are interrelated. According to McClatchie et al. [18] that performing lateral cervical glides at C<sub>5</sub>, C<sub>6</sub>, and C<sub>7</sub> may help with asymptomatic cervical shoulder pain and shoulder ROM as it improves the shoulder abduction painful arc and reduce the severity of pain.

The effect of cervical spine mobilization on peripheral symptoms is often overlooked, particularly when the patient is asymptomatic. This initiative shows that assessing and treating the central area of the spine, which is the cervical spine, will help with pain relief and peripheral joint ROM [19]. Therefore, this research has been conducted to determine the immediate and carryover impact of cervical mobilization (antero-posterior, lateral bending, and postero-anterior) on decreasing pain and improving external rotator and abductors muscle strength in rotator cuff tendinitis patients.

## Material & Methods

### Study design

A controlled, randomized, single-blind, pre-post-test experiment was planned for this study from the period between February 2021 to August 2021. The Institutional Review Board of Cairo University's Faculty of Physical Therapy gave the

study ethical permission before it began (P.T.REC/012/002948). This paper followed the Declaration of Helsinki Guidelines for the Conduct of Human Research. Clinical Trials.gov has been used to register the study protocol (NCT:04703660).

### Participants

This research involved seventy-five patients with rotator cuff tendinitis who were recruited from outpatient clinics of El Sahel and Benha Teaching Hospital with age were ranging from 25 to 40 years, and BMI between 25 and 30 kg/m<sup>2</sup>. Participants were screened and were excluded if they had previous fracture in cervical spine or shoulder, acute inflammatory condition. Malignant tumor, Multiple osteophytes, Cervical posture abnormalities, Osteoporosis, Malignant tumor, Multiple osteophytes, Cervical posture defects, Osteoporosis. A power analysis revealed that with the study's power of 78%, for each group the number of 25 patients was sufficient at the 95% confidence interval (CI). The purpose and essence of this research was clarified to all participants, and informed consent was signed by each one.

### Randomization

After being informed about the study's nature, purpose, and benefits, as well as the patients, right to turn down or withdrawal at any moment, as well as the secrecy of all information collected, each participant signed an informed written consent form. Using sealed opaque envelope techniques, subjects were assigned randomly into 3 groups. The sealed envelope was used with letter (A or B or C) before participation in the study. To hide the distribution, numbered envelopes were used. The randomization was limited to allow blocks to ensure that there were an equal number of participants in all groups. To ensure anonymity, all data was digitized. No drop out after randomization as shown in figure [1].

### Procedures

#### Assessment procedure

Visual analogue scale (VAS) which is widely considered as a reliable and precise measure of pain severity was used to determine the level of the pain [20]. Before and after the intervention, the patient has been instructed to mark the VAS line at the point which symbolizes the severity of his pain. The VAS score has been kept track of by measuring in millimeters from the line's left end to the point where the patients specify [21].

Nicholas Manual Muscle Tester (Lafayette Manual Muscle Tester) was used to measure muscle strength of external rotator and abductors before and after the intervention. It is designed to support the tester's hand and has a transparent output reading force window [22].

For external rotators: patient was asked to sit and keeping his arm on their side in neutral position with keeping the elbow bent 90° with a neutral position for the forearm (halfway between supination and pronation) with pointing the thumb upward. The dynamometer was placed on the dorsum surface of the wrist, immediately proximal to the ulnar styloid. The patient was instructed to contract completely as strongly as he could in lateral rotation against a hand held dynamometer (la-

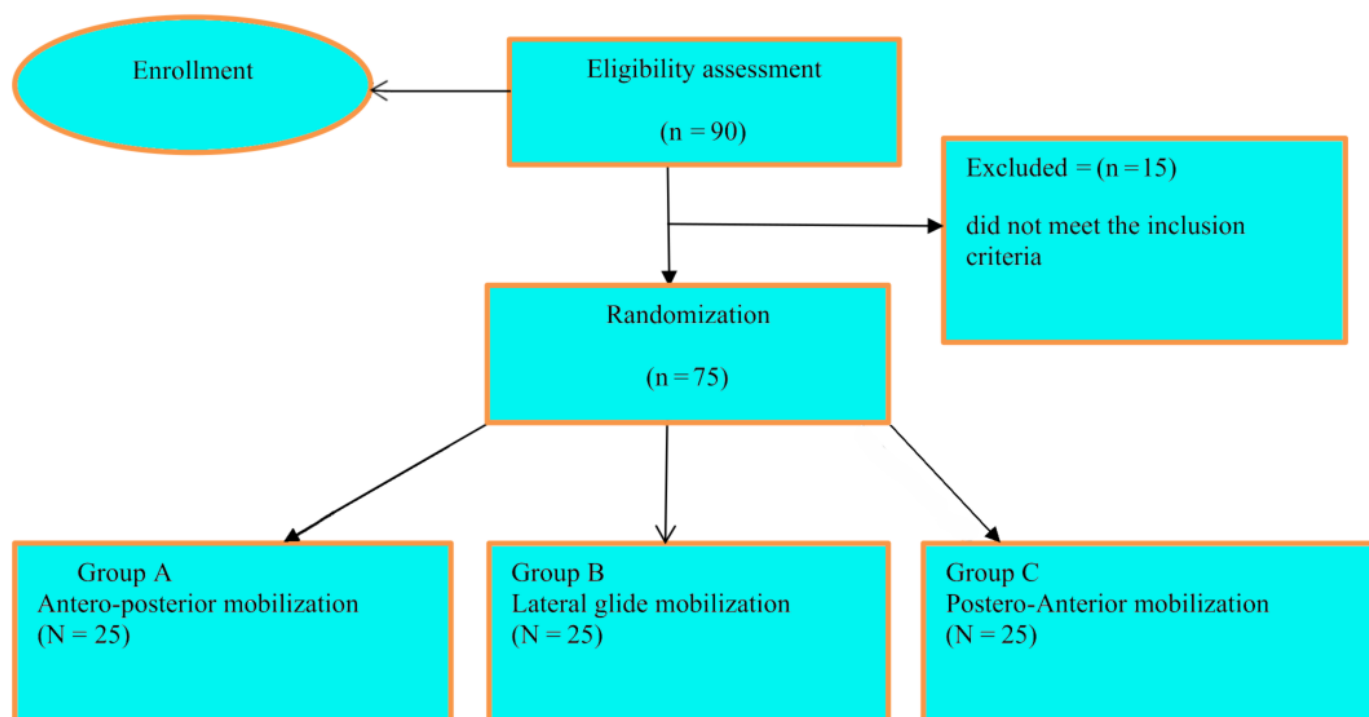


Figure. 1. Flow chart demonstrates the experimental design of the study

fayette muscle tester) [23]. For abductors, in a sitting posture, the patient was asked to keep his shoulder in abduction 30° and 90° flexion. For 5 seconds, the patient was requested to resist the force applied by the dynamometer in abduction against the instrument, that placed above the lateral epicondyle of elbow, as much as possible [24]. During the handheld dynamometry experiment, the peak isometric force in (kg) was measured and analysed. Every movement has been measured 3 times, with a ten-second rest in between.

### Treatment procedure

#### Therapeutic Ultrasound (US)

It's been widely utilised to treat musculoskeletal problems. For 8 minutes, continuous ultrasonic waves at a frequency of 1 MHz and a power of 1–1.5 watt/cm<sup>2</sup> were applied to the shoulder joint. The therapy was performed with circular movements and a 4 cm<sup>2</sup> US head; the device was calibrated on a regular basis before use [25].

#### Mobilization Techniques

**Group A (Antero-Posterior Mobilization):** The patient was lying supine. At the patient's head level, the therapist was standing and made broad contact with both thumbs to mobilize the transverse process of the vertebrae. As direct bone-to-bone touch could be painful, the thumbs should be used with caution. The fingers of the therapist were extended for stability across the adjacent area of the neck. The oscillatory antero-posterior grade III pressures are carried out very gently at

the C<sub>5</sub>/C<sub>6</sub>, 2 to 3 times per second for 5 minutes following Maitland's approach [26].

**Group B (lateral glide):** In the supine posture, the therapist used the palmar pad of one hand's thumb to the lateral aspect of the C<sub>5</sub>-C<sub>6</sub> zygapophyseal joint while stabilizing the opposing side of the head with the other hand, the Maitland grade III oscillatory approach is then used to apply the mobilization force in an inferior-medial direction at rate 1–2 times per second for five min. On the same side of the shoulder impingement, lateral glide mobilization has been performed [23, 27, 28].

**Group C: (Postero-Anterior Mobilization):** In prone position, at the patient's head level, Both thumbs of the therapist were held back to back, with the thumb tips on the spinous process at the C<sub>5</sub>-C<sub>6</sub> level. The fingers straddle the sides of the patient's neck and head. Grade III Oscillatory pressure directed posterior-anterior against spinous process following Maitland's approach (pressure with high amplitude reach up to the limit of the range) at rate 2–3 per second for 5 minutes at level of C<sub>5</sub>/C<sub>6</sub> [28].

### Results

#### General characteristics of study population

SPSS for Windows, version 20 was used for statistical analysis (SPSS, Inc., Chicago, IL). This study included 75 patients of both genders, who were divided into three groups of twenty-five individuals each. As shown in table (1), there was no significant difference in mean age, height, weight, or BMI between the three groups ( $p > 0.05$ ).



**Table 1. Descriptive statistics and t-test for comparing the mean age, weight, height and BMI of three groups**

|                          | Group A<br>Mean $\pm$ SD | Group B<br>Mean $\pm$ SD | Group C<br>Mean $\pm$ SD | f- value | p-value | Significance |
|--------------------------|--------------------------|--------------------------|--------------------------|----------|---------|--------------|
| Age [years]              | 28.2 $\pm$ 7.01          | 25.96 $\pm$ 5.27         | 25.2 $\pm$ 4.6           | 1.856    | 0.164   | NS           |
| Weight [kg]              | 79.8 $\pm$ 8.02          | 74.76 $\pm$ 8.36         | 78.8 $\pm$ 8.5           | 2.63     | 0.079   | NS           |
| Height [cm]              | 171.7 $\pm$ 7.5          | 168.56 $\pm$ 9.8         | 171.7 $\pm$ 10.26        | 0.974    | 0.382   | NS           |
| BMI [kg/m <sup>2</sup> ] | 27.08 $\pm$ 2.45         | 26.3 $\pm$ 2.01          | 26.87 $\pm$ 2.29         | 0.741    | 0.480   | NS           |

SD: Standard deviation, p value: Probability value, NS: Non significant

### Comparison within groups (A, B,C)

As shown in table (2), there were statistically significant differences in median values in shoulder external rotators, abductors, and pain level between pre, immediate

post-mobilization, 10 minutes post-mobilization, and 30 minutes post-mobilization within the three groups when using the Wilcoxon test.

**Table 2. Results of Kruskal-Wallis test and Friedman two way analysis between median values of measured variables between and within groups**

| Item                    | Pre-study<br>Median, (IQ) | Immediate Post-<br>mobilization<br>Median, IQ | 10 min Post-<br>mobilization<br>Median, IQ | 30 min Post-<br>mobilization<br>Median, IQ | Z-value | P-value |
|-------------------------|---------------------------|-----------------------------------------------|--------------------------------------------|--------------------------------------------|---------|---------|
| <b>External rotator</b> |                           |                                               |                                            |                                            |         |         |
| Group A                 | 8.9 (8.1–10.3)            | 10.3 (9–11.7)                                 | 10.6 (9.4–12.5)                            | 9 (8.4–10.6)                               | 76.3    | 0.001   |
| Group B                 | 7.6 (6.7–9.7)             | 8.5 (7.6–14.5)                                | 9 (7.8–15)                                 | 7 (6.8–13.4)                               | 66.6    | 0.001   |
| Group C                 | 8 (7–9.4)                 | 8 (7.1–9.1)                                   | 9.5 (7.6–9.9)                              | 8.2 (7.1–9.3)                              | 56.5    | 0.001   |
| ( $\chi^2$ -value)      | 4.22                      | 11.43                                         | 10.57                                      | 4.37                                       |         |         |
| P-value                 | 0.121                     | 0.003*                                        | 0.005*                                     | 0.112                                      |         |         |
| <b>Abductor</b>         |                           |                                               |                                            |                                            |         |         |
| Group A                 | 7.9 (7.1–10.4)            | 9 (8–11.1)                                    | 9.2 (8.2–11.4)                             | 8 (7.2–10.2)                               | 70.13   | 0.001   |
| Group B                 | 7.8 (6.9–9.1)             | 8.7 (7.8–10)                                  | 9 (8.2–10.5)                               | 7.7 (7–9.2)                                | 68.08   | 0.001   |
| Group C                 | 8.1 (6.9–10.4)            | 9.2 (7.6–11.2)                                | 9.5 (8–11.4)                               | 8.2 (7–10.3)                               | 66.2    | 0.001   |
| ( $\chi^2$ -value)      | 0.815                     | 0.408                                         | 0.236                                      | 1.15                                       |         |         |
| P-value                 | 0.665                     | 0.816                                         | 0.889                                      | 0.561                                      |         |         |
| <b>VAS</b>              |                           |                                               |                                            |                                            |         |         |
| Group A                 | 7 (6–8)                   | 4 (3–4)                                       | 4 (3–4)                                    | 6 (5–6)                                    | 69.6    | 0.001   |
| Group B                 | 7 (6–8)                   | 4 (3–5)                                       | 4 (3–4)                                    | 6 (5–6)                                    | 68.6    | 0.001   |
| Group C                 | 7 (6–8)                   | 5 (4–6)                                       | 6 (5–6)                                    | 7 (5.5–7)                                  | 63.06   | 0.001   |
| ( $\chi^2$ -value)      | 0.333                     | 30.5                                          | 43.3                                       | 7.98                                       |         |         |
| P-value                 | 0.847                     | 0.001*                                        | 0.001*                                     | 0.018*                                     |         |         |

\*: significance

### Comparison between Three groups (A, B,C)

Kruskal-Wallis test and Friedman two way analyses were used to compare between three groups, There was no statistically significant difference in the three groups' pre-study median values of external rotators, abductors, and pain level.

For external rotators: there were statistically significant diffe-

rences in immediate post-mobilization and in 10 minutes post mobilization median values of external rotator strength between the three groups. While there were no statistically significant differences in 30 minutes post-mobilization median values of external rotator strength among the three groups as shown in table (2).

For Abductors: There were no statistically significant differences in immediate post-mobilization, 10 minutes post mobilization, and 30 minutes post mobilization median values of abductors among the three groups as shown in table (2).

For VAS: There was statistically significant difference in immediate post-mobilization, 10 minutes post mobilization, and

30 minutes post mobilization median values of VAS among the three groups as indicated in table (2).

Pairwise comparison among groups has been used to compare between pre, immediate post mobilization, 10 minutes post mobilization, and 30 minutes post mobilization for external rotators, abductors, and pain level in three groups showed in tables (3, 4, 5).

**Table 3. Pairwise comparison within groups in the median values of external rotators**

| External rotators                                     | Group A<br>p- value | Group B<br>p- value | Group C<br>p- value |
|-------------------------------------------------------|---------------------|---------------------|---------------------|
| Pre-study vs. immediate post-mobilization             | 0.001*              | 0.001*              | 0.004*              |
| Pre-study vs. 10 minutes post-mobilization            | 0.001*              | 0.001*              | 0.001*              |
| Pre-study vs. 30 minutes post-mobilization            | 0.927               | 0.990               | 0.331               |
| Immediate post-study vs. 10 minutes post-mobilization | 0.129               | 0.071               | 0.001*              |
| Immediate post-study vs. 30 minutes post-study        | 0.002*              | 0.001*              | 0.835               |
| 10 minutes post-study vs. 30 minutes post-study       | 0.001               | 0.001*              | 0.001*              |

**Table 4. Pairwise comparison within groups in the median values of abductor**

| Abductor                                              | Group A<br>p- value | Group B<br>p- value | Group C<br>p- value |
|-------------------------------------------------------|---------------------|---------------------|---------------------|
| Pre-study vs. immediate post-mobilization             | 0.001*              | 0.001*              | 0.001*              |
| Pre-study vs. 10 minutes post-mobilization            | 0.001*              | 0.001*              | 0.001*              |
| Pre-study vs. 30 minutes post-mobilization            | 0.751               | 0.990               | 0.990               |
| Immediate post-study vs. 10 minutes post-mobilization | 0.037*              | 0.037*              | 0.129               |
| Immediate post-study vs. 30 minutes post-study        | 0.001*              | 0.001*              | 0.001*              |
| 10 minutes post-study vs. 30 minutes post-study       | 0.001*              | 0.001*              | 0.001*              |

\*: significance

In both the immediate and 10-minute post-mobilization for external rotators, post-hoc tests revealed significant differences between groups A and C in favor of group A, as well as significant differences between groups B and C in favor of group B, as shown in table (6). While a post hoc test for com-

parison between groups 30 minutes after mobilization showed substantial differences between groups A and C only in favor of group A, as shown in table (7) for VAS. For abductors, there was no significant differences among the three groups (A,B,C).

**Table 5. Pairwise comparison within groups in the median values of VAS**

| VAS                                                   | Group A<br>p- value | Group B<br>p- value | Group C<br>p- value |
|-------------------------------------------------------|---------------------|---------------------|---------------------|
| Pre-study vs. immediate post-mobilization             | 0.001*              | 0.001*              | 0.001*              |
| Pre-study vs. 10 minutes post-mobilization            | 0.001*              | 0.001*              | 0.001*              |
| Pre-study vs. 30 minutes post-mobilization            | 0.292               | 0.602               | 0.375               |
| Immediate post-study vs. 10 minutes post-mobilization | 0.999               | 0.999               | 0.999               |
| Immediate post-study vs. 30 minutes post-study        | 0.001*              | 0.001*              | 0.001*              |
| 10 minutes post-study vs. 30 minutes post-study       | 0.001               | 0.001*              | 0.001*              |

\*: significance



**Table 6. Post-hoc test for comparison between groups in the median values of external rotators immediate post-study and 10 minutes post-study**

| External rotators   | Immediate post-mobilization<br>p-value | 10 minutes post-mobilization<br>p-value |
|---------------------|----------------------------------------|-----------------------------------------|
| Group A vs. group B | 0.161                                  | 0.063                                   |
| Group A vs. group C | 0.002*                                 | 0.005*                                  |
| Group B vs. group C | 0.448                                  | 0.990                                   |

\*: significance

**Table 7. Post-hoc test for comparison between groups in the median values of VAS immediate post-mobilization, 10 minutes post-mobilization and 30 minutes post-mobilization**

| VAS                 | Immediate post-mobilization<br>p-value | 10 minutes post-mobilization<br>p-value | 30 minutes post-mobilization<br>p-value |
|---------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|
| Group A vs. group B | 0.626                                  | 0.990                                   | 0.652                                   |
| Group A vs. group C | 0.001*                                 | 0.001*                                  | 0.014*                                  |
| Group B vs. group C | 0.001*                                 | 0.001*                                  | 0.339                                   |

\*: significance

## Discussion

Manual treatment is well-known for its effectiveness in relieving pain, enhancing range of motion, and correcting posture [29]. In several circumstances, manual treatment on the spine is used to treat spinal issues. Limited shoulder movement can be induced by joint issues as well as pain from cervical nerve compression, according to Schneider [30].

According to the results, there was statistically significant differences in pain reduction and increased shoulder external rotator strength and abductors between pre, immediate post-mobilization, 10 minutes post-mobilization, and 30 minutes post-mobilization median values within the three groups. It also demonstrated that the immediate post-mobilization and 10-minute post-mobilization median values of external rotators differed statistically significantly across the three groups, but no statistically significant differences in the 30 minute post-mobilization median values of external rotators and there was no statistically significant differences in abductors median values immediately after mobilization, 10 minutes after mobilization, or 30 minutes after mobilization between groups, but there were statistically significant differences in VAS median values immediately after mobilization, 10 minutes after mobilization, and 30 min following mobilization among the three groups. So according to the findings of this study, cervical mobilization was useful in decreasing pain and improving external rotators and abductors strength in rotator cuff tendonitis patients.

There are multiple mechanisms suggest that low-velocity passive mobilization on the spine enhancing muscle strength; those include facilitation of joint mechanics [31, 32, 33], central facilitation [34] and influence of the sympathetic nervous system [35, 36]. The cervical AP mobilization can stretch and increase the extensibility of the joint tissues, allowing mechanoreceptors to work more effectively [31, 32, 33].

Studies suggested that the reference pain which causes reduced shoulder joint mobility may originate in the neck. They further claimed that shoulder joint motion and cervical motion are interrelated [17]. Also It was explained by McClatchie et al. [18]. that a decline in arm pain and enhancement of shoulder painful range of motion resulted from mobilizing the C<sub>5</sub> spinous process, as mobilization treat the neurological problem that hindered the shoulder joint.

It was postulated that management of rib articulations, cervical and upper thoracic spine was beneficial in the treatment of sufferers having shoulder issues, according to Sobel et al. [37].

Wang and Meadow [23] claimed that abductor muscle strength of the shoulder joint enhanced following C<sub>5</sub>–C<sub>6</sub> joint mobilization, this improvement in shoulder abductor strength lasted for 10-20 minutes which come in agreement with the result of our study. EMG studies and other outcome measures indicated that there is general decrease in hypertonicity in cervical and back area after spinal manipulation at different levels C<sub>2</sub>–C<sub>3</sub>, Th<sub>2</sub>–Th<sub>3</sub>, Th<sub>5</sub>–Th<sub>7</sub>, Th<sub>11</sub>–Th<sub>12</sub>, L<sub>2</sub>–L<sub>4</sub>, and sacrum) but deltoid is not affected [38].

According to Wang and Meadow [23], the mobilization of the segmental joint at C<sub>5</sub>–C<sub>6</sub> had a direct effect on the C<sub>5</sub> reflex pathway, resulting in peripheral changes, such as the reduction of the external shoulder rotator's inexorable weakness. They also found that after the joint mobilization with 30 minutes, the power of shoulder external rotator muscles remains the same as it was before application of mobilization. The previous explanation agree with our results that all improvements occurred immediately and 10 minutes after mobilization in pain reduction and strength of external rotators, but not in abductors.

The findings of this study supported those [39, 40], who discovered that following spinal joint mobilization, muscle inhibition in the extremities (quadriceps femoris and biceps, respectively) was decreased. Suter et al. [39] proposed that the inhibition of extremities muscles is caused by inhibitory stimu-

li from the spine. When compared to people who did not have neck pain, Suter and McMorland [40] discovered that chronic neck pain sufferers had more than 5% muscular inhibition in the Biceps Brachii.

The mobilized joints' mechanoreceptors and proprioceptors are thought to be activated by spinal mobilization or manipulation. The efferent segmental level pathways are affected by the mobilization of the joints of the spine, which delivers sensory inputs capable of overriding the already present aberrant sensory inputs. By delivering afferent input, joint mobilization can help recover muscular inhibition or other facilitated section symptoms [41].

One of the mechanisms that explain the effect of mobilization is the central facilitation which is defined as a rise in the receptive region of central neurons in a damaged spinal segment (facilitated segment), allowing subthreshold or benign stimuli to penetrate the central route [41, 42]. By eliminating subthreshold chemical or mechanical inputs from a malfunctioning spinal segment and influencing reflex neural output to the peripheral muscles, spinal joint mobilization has been capable of affecting central sensory processing [43].

Pikura J R [44], who conducted research on the effect of spinal manipulations on the immediate relief of pain as well as range of motion, backed with the current findings. Following just one therapy, the researchers noticed a reduction in pain and an enhancement in motion range. Youngjoon et al. [45] found that cervical mobilization enhanced shoulder muscular strength, corrected spinal mal-alignment, and stimulated joint mechanoreceptors with no risk of manipulation.

Limitations of the study: because the effect of gender on the results was not determined in this study, future research should include gender as a variable. Another study is needed to see how different types of spinal mobilization affect different shoulder issues and at different segmental levels over time.

### Conclusion

According to the findings of this study, there are three types of cervical mobilization such as antero-posterior, postero-anterior and lateral gliding are effective in decreasing pain, improving strength of external rotators and abductors muscles in patients with rotator cuff tendinitis immediately and 10 min after cervical mobilization, the study also revealed that the most effective method is antero-posterior then lateral glide and the least effective one is postero-anterior method of cervical mobilization.

### Practical Applications

These results will help the physical therapist to determine the most effective type of cervical mobilization that is antero-posterior mobilization which has an effect on decreasing pain and increase muscles strength of abductors and external rotators in rotator cuff tendinitis patients.

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