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Scapulothoracic Mobilization for the Management of Lateral Epicondylalgia: a Case Report

Jong Won Kim[1], tae jun Heo[2], Ji-Won Park[1]

[1]Department of Physical Therapy, Daegu Catholic University, Gyongsan, Republic of korea; [2]Pureun Cheong Neurology Clinic, Daegu, Republic of Korea

Purpose: The purpose of this study was to investigate the effects of the scapulothoracic mobilization on subject with lateral epicondylalgia. This was done through lateral slide scapular test, grip strength, visual analogue scale, glenohumeral joint external rotation range of motion.

Methods: Before the experiment, Lateral slide scapular test, grip strength, visual analogue scale, glenohumeral joint external rotation range of motion were measured. Scapulothoracic joint mobilization was applied and then measurements were taken again to compared the changes.

Results: After applying the scapulothoracic joint mobilization, lateral slide scapular test, grip strength, visual analogue scale, glenohumeral joint external rotation range of motion significantly improved.

Conclusion: This study found that the scapulothoracic mobilization was effective in improving functional aspects and pain on subject with lateral epicondylalgia. The results suggest that the scapulothoracic joint mobilization is a significant considered intervention method that could be used for subject with lateral epicondylalgia.

Keywords: Lateral epicondylalgia, Scapular, Thoracic vertebrae

INTRODUCTION

The lateral epicondylitis, often called tennis elbow, is an tendinopathy involving the extensor digitorum of the lateral epicondylitis.[1] It is commonly found in people exposed to repeated and vigorous use of the forearm, biased wrist posture, and repeated grabbing.[2] In accordance with Shiri,[3] about 12.2% of working population have lateral epicondylitis. In addition, extensor tendons of the patients who experienced pain during the extension resistance test showed changes in the fibroblast and vessels, which is part of the degenerative change. Such degenerative tendinosis results from the excessive stress on the extensor carpi radialis brevis among the extensor tendons.[4] In response to such research results, most curative approaches tend to focus on intervening the elbow parts under the assumptions on damaged elbow joint mobility and extensor muscles of the wrist.[5]

When considering the arm lines of the fascia, however, the problems associated with arm, hand, and shoulder are caused by the compensation pattern related to the arm lines. In addition, tender points in elbow are caused by the bad posture and lack of support. The front arm lines pass along the thumb, radius, biceps brachii muscle, and pectoralis minor muscle while superficial back line passes along the backhand, lateral epicondyle, deltoid, acromion, spine of scapula, and trapezius. Especially, the superficial back arm line is involved in the external rotation of the shoulder and it is often overused in the bad postures such as crooked shoulder and crooked vertebrae.[6] When expanding this to the concept of kinetic chain exercise, the scapula, shoulders, and arms harmoniously cooperate together to deliver, absorb, and generate force.[7] On the other hand, the intermediate back muscles surrounding the scapula are associated with the stability of neck, shoulders, and elbows. These muscles provide a strong surface for all shoulder and arm movements. Theoretically, the tissues of the distal limb segments require much more energy to function when the ability to maintain the scapular stability is damaged.[8] When the upper limbs perform the functional movement, the kinetic energy gets delivered from the upper body part to distal segments. If the scapular motion changes during the daily living, the distal segments increase the energy

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Corresponding author Ji-Won Park
E-mail mylovept@hanmail.net

demand during the activities of daily living. This would result in reducing the shoulder stability and the increased energy demand would cause injuries due to overused elbows.[9,10] Generally, the external force generated by the ground reaction force and gravitational force acting on joints are offset by joint's soft tissues and other muscles. When the center of gravity change with bad posture, however, this results in excessive external force from the gravitation and the body requires excessive internal force to balance the gravitational force and external force.[11,12]

Especially, scapula has a significant effect on the upper limbs. According to the research by Alexander and harison,[13] the research claimed that there exist a reflexive relation between hand muscle's afferent nerves and scapular muscles. The research also pointed out that serratus anterior and trapezius are activated during the flexion of lower arms and hand muscles while the scapular is adjusted and maintained during the arm lifting. The previous researches also showed the close relationship between the overused elbow and symptoms in shoulders or scapula.[14] The researches by Smidt et al.[15] also pointed out that the lateral epicondylitis patient's negative prognosis is related to the shoulder pain. The research by Suzuki et al.[16] examined the changes in the elbow kinetics caused by the scapular muscle fatigue of the healthy men. According to this research, the scapular fatigue is assumed as the result of the compensatory motion of the elbows in relation to the elbow disorders. The research also pointed out that changes in scapular motion are related with shoulder disorder, affect the functions of distal upper muscles, and cause injuries due to overused muscles including the wrist extensor.[17] Such scapular dyskinesis is defined as the alteration in the scapular position and movement pattern and it is commonly associated with the shoulder disorders.[18] According to the research by Tripp et al.[19] on the change of body alignment due to scapular dyskinesis, the mechanism responsible for fatigue causes the change in position of scapula, glenohumeral joint, and elbow joint and such defects affected on changing the arm position. According to research by Phadke,[20] it may also lead to deformity in the articular surface of the elbow, scapula, and glenohumeral joint. This also increases the risk of neck pain, shoulder pain, and non-specific arm pain.[21] The research by Day10 also reported that the lateral epicondylitis patients showed scapular dyskinesis due to weakening of scapular muscles.

The sway-back posture also influences on the kinetics of the scapula and glenohumeral joint.[22] The increased flexion of the back spine may reduce the range of raising the glenohumeral joint.[22] In addition, the reduced range of scapular tilting and increased range of scapular raise are observed while raising the shoulders.[23] The sway-back posture also changes the center of gravity and causes the compensation movement.[22] Such misaligned body posture is widely known as a slumped posture.[24] The curves of the changed thoracic spine influence on the shoulder girdle through the muscle insertion points and eventually change the length-tension relationship of the scapular muscles.[25] The increased sway-back posture observed in in the slumped posture decreases the shoulder joint's range of motion.[26] The slumped posture also has a negative kinematic impact on the scapular and glenohumeral joint while the increased flexion of back spine results in reducing the glenohumeral joint's range of motion.[27] The shoulder girdle is a complex musculoskeletal system which requires the coordination of muscle fascicles branching from the thoracic wall and elbows. The bones consisting the shoulder girdle influence on each other. The increased scapulothoracic joint movement for raising the arm glenohumeral joint leads to higher shoulder joint strength. The increase in space between the humerus head's radius and glenohumeral joint results in more shoulder joint strength. The space between the humerus head's radius, acromion, and humerus and movement of scapula leads to kinematic influence on the glenohumeral joint.[28] The increase in space between humerus head's radius and humerus also increase the muscle weight. Eventually, the muscle force, in other words, joint force, will decrease.[29] Thus, the change in shoulder girdle due to severe sway-back posture may result in narrowing the subacromial space and shortening the humerus head's radius. Furthermore, the tension in the shoulder girdle may increase the kinematic on the glenohumeral joint and elbow joint.

The movement of scapulothoracic joint is also considered as an important clinical index and recovering the normal kinematics of scapulothoracic joint is one of the main goals in the non-surgical physical therapy and post-surgical rehabilitation.[29] Surenkok et al.[30] applied a scapular joint manipulation on patients with shoulder pain and limited shoulder movement and reported that the manipulation had positive effects on the upward scapular rotation and shoulder joint's range of motion. There are also various potential mechanisms, such as the referred pain from neck or back, which may influence on the lateral on patients.[31] The disorders caused by neck and back pain are commonly known for causing the referred pain in the lateral elbow areas[32] and other numbers of researches also pointed out that lateral epicondylitis patients show extensive mechanical pain and hyperalgesia at the same time.[33,34]

The first phase of hyperalgesia is the tissue injuries and this leads to changes in the afferent nerve's pain receptors and peripheral sensitization associated with increasing the neural reaction against the harmful stimulation, and lowering the threshold level against the harmful stimulation.[35,36] The according hyperalgesia is defined as the lowering of the pain threshold level against the harmful stimulation and it is divided into two types; The primary hyperalgesia occurs at the site of injury and the secondary hyperalgesia occurs at areas surrounding the injury site. The primary hyperalgesia is associated with the lowering of pain threshold level against the mechanical pain and thermal stimulation while the secondary hyperalgesia is associated with lowering of pain threshold level against the mechanical pain.[37] Since lateral epicondylitis patients often show mechanical pains more than thermal hyperalgesia, the patients show the characteristics of the secondary hyperalgesia.[38,39] Considering such grounds, Scapulothoracic mobilization on neck is effective for treating the lateral epicondylitis patients.[40]

For the purpose and hypothesis, this paper targeted on the influence of back spine joint and scapular muscle relaxation on the balance of scapula, functional recovery of upper body, and elbow pain relief. This paper examined the effects of joint manipulation intervention on back spine joint and scapula for balancing the scapular, recovering the upper body functions, and relieving the pains of lateral epicondylitis. There are only few researches that targeted on the organically connected segments in the elbow pain patients. While there have been researches on the topical elbow treatments, there needs to be active clinical researches on the elbow pain caused by the functional defects of the organically connected body segments. Such clinical researches hold a significance for allowing the therapists to have more diverse intervention approaches to elbow pain patients by assuming the organic connection between the multiple segments.

METHODS

1. Subjects

This paper targeted on a subject who has been experiencing the trigger points on the lateral epicondyle for about 1 year without getting any musculoskeletal surgery and past treatment history. In addition, no other treatment was performed during the experimental period. This paper conducted Cozen Test and Maudsley widely used for the medical diagnosis of lateral epicondylitis and the subject was positive for lateral epicondylitis.[41] The subject also showed sway-back posture, uneven scapula, and pain during glenohumeral joint external rotation. The subject was a right-handed, 59-year-old male with height, weight, and BMI of 172.4cm, 71.0 kg, and 23.3kg/m^2. The subject signed an agreement form before the tests and was given the detailed explanations in advance.

2. Experimental methods

1) Procedure

This paper was conducted by adopting the format of case report. Total of 10 interventions were performed for 10 minutes and twice a week. The last 10th intervention was performed in two-week interval from the previous intervention to track the effects. After measuring the pre-intervention range of motion for shoulder, lateral slide scapular test (LSST), grip strength, and visual analogue scale (VAS), this paper referred to the Osteopathy Articulation and Manipulation Techniques, performed the scapulothoracic mobilization and scapular mobilization for five minutes respectively, and measured the post-intervention range of motion, LSST, grip strength, and VAS.

2) Measurement

(1) Range of Motion for Shoulder

For the objective measurement of the range of motion for shoulders, this paper used an integrated musculoskeletal analysis system, Exbody 720 PA (Exbody Inc., Seoul, Korea), and used the Exbody posture analyzer software program to quantify. To secure the reliability of measurement, the same tester instructed the measurement posture of the subject for every session. To measure the angle, the subject was instructed to step on a measurement device, stand on side, and perform the shoulder joint external rotation while abducting the shoulder joint to 90 degrees and bending the elbow to 90 degrees (Figure 1).

(2) Lateral Scapular Slide Test (LSST)

To quantify the uneven scapular in objective figures, this paper conducted a reliable assessment method, LSST Test. The test was performed in three positions. Position 1 involves standing on a neutral position, with the arms relaxed at the sides. Position 2 involves placing the hands on the lateral iliac crest and putting the thumb to back. Position 3 involves keeping the arms abducted to left and right sides. In the test, the differences in left and

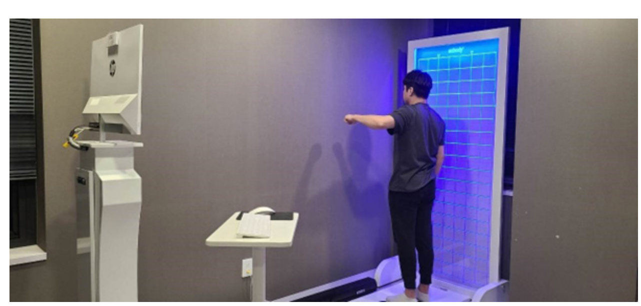

Figure 1. The picture of measurement of the range of motion using the X-body.

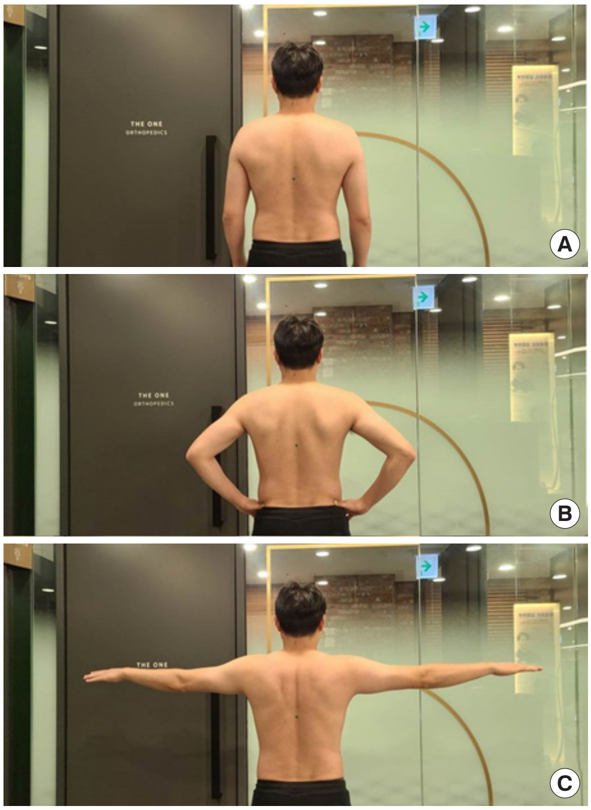

Figure 2. Three position for the lateral scapular slide test. (A) First position: arms at the side. (B) Second position: hands on the hips. (C) Third position: arms at or below 90° abduction, with glenohumeral internal rotation.

right sides were compared by moving horizontally in spinal directions from the inferior angle of the scapula and measuring the distance to the vertical line formed by the spinous process of the vertebra (Figure 2).[7]

(3) Grip strength

For the objective measurement of the grip strength, this paper used a digital dynamometer (Commander™ Grip Track, J-Tech™, Chester springs, USA). The subject was made to keep a sedentary position, bend knee joints by 90-degrees, and put the arms on a desk for a natural 90-degree elbow angle to put the low arms in a neutral position. The grip strength was measured total of three times for 5 seconds from the measurer's signals of "Start" to "Stop". The subject was also given a one-minute break time between each measurement to prevent the variables associated with the muscle fatigue.[42]

(4) Visual Analog Scale (VAS)

To measure the subjective pain of the subject before and after the treatment, this paper used VAS (Visual Analog Scale) to measure the degree of pain felt at the trigger points at lateral epicondyle. Then, the subject was instructed to place a mark on a 100 millimeter-long line to describe the pain. The subject was given the explanation on the left (no pain) and the right (extreme pain) of the line. The subjective pain was measured by measuring the length from the mark placed by the subject to the left side.[43]

To enhance the reliability of the measurement, the range of motion, LSST, grip strength, and VAS of the subject were measured before and after the intervention by a physical therapist with over 9 years of clinical experiences. To minimize the confounding variables, the measurement and intervention were performed by different people. All the interventions were performed by a physical therapist with over 8 years of clinical experiences. In addition, the measurement and intervention were performed under the identical conditions and procedures from January 21, 2022 to March 7, 2022 for the standardization.

3) Intervention

This paper referred to Osteopathy Articulation and Manipulation Techniques and performed the two types of interventions, Scapulothoracic mobilization and scapular mobilization, for five minutes respectively.

(1) Scapulothoracic mobilization

The subject lied flat on a pillow and the interventionist crossed the both arms of the subject so that each hand would touch the scapular of the opposite side. Then, interventionist used a distal arm to hold the overlapping elbow part in place and to hold and pull the distal shoulders. The other arm was placed on vertebrae with a loosely clenched fist. After the subject lied flat on the back and crossed the elbows, the subject's low arm was pressured to mobilize the vertebrae. The Scapulothoracic mobilization was performed by checking on the various ranges of motion including rotation, label flexion, flexion, and translational motion in the spinal traction direction (Figure 3).

(2) Scapular mobilization

The subject lied in a lateral recumbent position on a pillow facing the interventionist, bended elbow and placed the upper arm on a navel, and bended both knees. The interventionist stood close to the subject's trunk and placed fingers under the medial border of the scapula to hold the scapula. Then, the interventionist placed the sternum to hold the subject's shoulders in place, hold scapular in both hands, and perform the mobilization (Figure 3).

3. Statistical Analysis

To verify the effects of Scapulothoracic mobilization and scapular mobilization, this paper came up with the descriptive statistics on the pre-intervention and post-intervention measurements for the first and the last day. To examine the changes in the subject during the test, this paper made a visual graph on the pre-intervention and post-intervention measurements for every session and compared the changes in range of motion, LSST, grip strength, and VAS.

Figure 3. The picture of application of therapeutic interventions. (A) Scapulothoracic mobilization. (B) Scapular mobilization.

RESULTS

After applying the scapulothoracic joint mobilization on the subject with lateral epicondylalgia, lateral slide scapular test and grip strength of the function significantly improved. In addition, visual analogue scale of pain significantly decreased.

1. Change in ROM

In Figure 4A, this paper visualized the changes in the range of motion for the shoulder external rotation before and after the Scapulothoracic mobilization and scapular mobilization. On the first day, the range of motion started from 84° and improved to 91° after the intervention. The subject showed constant improvements throughout the test. In the 9th session, the range of motion started from 99° to 150° after the intervention. Compared to the first day, the pre-intervention angle improved by 15° and post-intervention angle improved by 14°. The follow-up test was performed after two weeks and the subject maintained the intervention effects with pre-intervention and post-intervention angles of 100° and 105° respectively (Figure 4).

2. Change in Grip strength

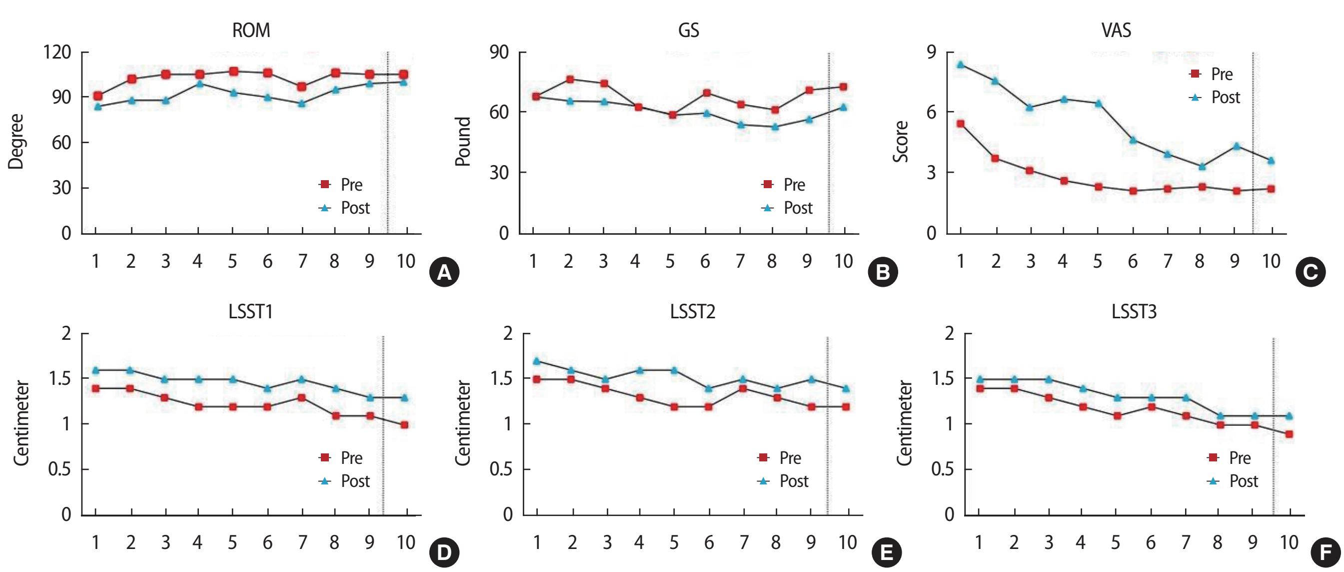

Figure 4. Graph of changes in measurements during the experiment.

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In Figure 4B, this paper visualized the changes in the grip strength before and after the Scapulothoracic mobilization and scapular mobilization with a graph. On the first day, the grip strength started from 67.67 lb and slightly improved to 68 lb after the intervention. Throughout the test, the pre-intervention grip strength slightly decreased while post-intervention grip strength remained. In the 9th session, the pre-intervention grip strength was 56.67 lb and post-intervention grip strength was 71 lb. Compared to the first day, pre-intervention grip strength reduced by 11 Ib while post-intervention grip strength increased by 3 lb. The follow-up test was performed after two weeks and the subject maintained the intervention effects with pre-intervention and post-intervention grip strengths of 62.67 lb and 72.67 lb respectively (Figure 4).

3. Change in VAS

In Figure 4C, this paper visualized the changes in the VAS before and after the Scapulothoracic mobilization and scapular mobilization with a graph. On the first day, the pre-intervention VAS was 8.4 and post-intervention VAS was 5.5. The subject showed gradual improvements in VAS throughout the test. In the 9th session, the pre-intervention VAS was 4.4 and post-intervention VAS was 2.2. When compared to the first day, the pre-intervention VAS decreased by 4 while post-intervention VAS decreased by 3.3 on the 9th session. In the follow-up test given after two weeks, the subject maintained the intervention effects with pre-intervention and post-intervention VAS of 3.7 and 2.3 respectively (Figure 4).

4. Change in LSST

In Figure 4D, E, F this paper visualized the changes in the LSST for measuring uneven scapular before and after the Scapulothoracic mobilization and scapular mobilization with a graph. In position 1, the subject started with 1.6 cm difference before the intervention and improved to 1.4 cm after the intervention. The subject gradually improved LSST as the test proceeded. In the 9th session, the subject showed the pre-intervention and post-intervention of 1.3 cm and 1.1 cm respectively. Compared to the first day, the pre-intervention and post-intervention difference decreased by 0.3 cm respectively on the 9th session. In the follow-up test performed two weeks later, the subject maintained the intervention effects with pre-intervention and post-intervention difference of 1.3 cm and 1 cm respectively. In the position 2, the subject started with 1.7 cm and improved to 1.5 cm on the first day and the subject consistently improved along the test. In the 9th session, the subject showed the pre-intervention and post-intervention of 1.5 cm and 1.2 cm respectively by decreasing 0.2 cm and 0.3 cm. In the follow-up test performed two weeks later, the subject kept the intervention effect with pre-intervention and post-intervention difference of 1.4 cm and 1.2 cm respectively. In position 3, the pre-intervention difference was 1.5 cm and post-intervention difference was 1.4 on the first day with gradual improvements along the sessions. In the 9th session, the pre-intervention and post-intervention differences were 1.1 cm and 1cm respectively showing the decrease by 0.4 cm compared to the first day. In the follow-up test given two weeks later, the subject maintained the intervention effect with pre-intervention and post-intervention difference of 1.1 cm and 0.9 cm respectively (Figure 4).

DISCUSSION

The scapulothoracic joint movement is closely associated with the humerothoracic axial rotation during the arm raise, external rotation, and lateral adduction with the upward scapular rotation.[44] According to the research by Smidt et al.[15] the lateral epicondylitis patient's negative prognosis is related to the shoulder pain. The vertebral posture also has kinematic influence on the scapular and glenohumeral joint. The increased vertebral flexion results in reducing the range of motion for the glenohumeral joint.[27] Ucurum et al.[9] also pointed out that the muscles associated with shoulder external rotation are weakened by the compensatory injuries from the wrist extensor. The research also found out that lateral epicondylitis patients show weaker shoulder external rotation compared to the normal group. Lucado et al.[17] also claimed that the weakening of the shoulder external rotation muscles increases the movement of distal segments and causes the lateral epicondylitis. In this paper, the subject also showed a limited range of motion due to the pain during the shoulder external rotation. To examine the increase in the shoulder joint's range of external rotation from increased functional movement of the spine, this paper measured the range of lateral glenohumeral joint rotation before and after the intervention. According to results, the subject showed improvement in the range of shoulder external rotation, which was limited due to the shoulder pain. The subject also maintained and improved the range of motion for each session. In the follow-up test given after two weeks, the subject maintained the intervention effect, too.

In the kinematic chain, shoulder girdle is composed of the scapular, shoulder, and arms and these components organically cooperate together to deliver and absorb force for the movement.[7] The previous researches pointed out that the overused elbow is mainly associated with shoulder and scapular dyskinesis[14] and that the uneven scapular is associated with dysfunction and injuries of the upper limbs. In addition, Kibler et al.[7] used the lateral scapular side test (LSST) to examine the relationship between the reduced muscle stability and distance between scapular and vertebrae in the shoulder and shoulder joint dysfunction. To examine the scapular alignment, the muscular force was quantified as a scapular stabilizer and reliable LSST test was adopted to measure the uneven scapular. In LSST, lateral epicondylitis patients showed higher positive rates and also involved the low shoulder external rotation, grip strength, and low muscular force of trapezius and middle trapezius.[9] According to the research results, the lateral epicondylitis patient showed lower positive rates in 3 LSST positions after the treatment and the rates also decreased over the sessions. The lateral epicondylitis also maintained the intervention effect in the follow-up test performed after two weeks.

Numbers of researches reported the reduction of grip strength in the lateral epicondylitis patients.[45] Such weakening of grip strength is related to weakening of upper body due to closed kinetic chain in the distal segments.[46] It was also observed that the lateral epicondylitis patient shows higher grip strength by holding the scapula in place.[5] In the test, the subject showed remarkable increase in the grip strength after the intervention. However, the grip strength gradually weakened over the session and eventually returned to the original grip strength. In addition, the subject showed the same results in the follow-up test given after two weeks. The weakening of grip strength is associated with weakening of upper body due to distal segments' closed kinetic chain.[5] Mandalidis et al.[47] also showed the relationship between the grip strength and shoulder muscle strength of the healthy people. Thus, it is assumed that the subject's grip strength weakened over the session due to lack of interventions for strengthening the muscles around scapula and shoulder girdle.

The scapular mobilization recovers the range of scapular motion, reduces frozen shoulders, and strengthens the proprioception to sense location. In addition, joint manipulation technique reduces the pressure to recover the contracted tissues such as shortened or fibrosis muscle tissues around the joint.[48] In a research by Fanti,[49] it was reported that scapular mobilization relieves the anterior tilt, medial rotation, downward rotation, and protrusion. The scapular mobilization also changed the scapular stabilizer position. In the research by Berglund,[50] 16 of patient groups didn't experience pain while 70% of lateral epicondylitis patients experienced pain in cervical vertebrae and back vertebrae. In addition, lateral epicondylitis patients were highly positive in the provocation test on the cervical and back vertebrae as well as the neural manipulation on the radial nerve. The back vertebral manipulation improves the limited range of motion in the spine, recovers the sliding in the articular surface, and normalizes the articular capsules to relieve the sway-back posture and strengthen the flexibility in the back extension. Such improved range of motion in the vertebrae is reported to improve the pulmonary function.[51] Moreover, the Scapulothoracic mobilization is reported to alter the muscular strain, relieve the excessive strain,[52] facilitates the neural pathway, and controls inhibition to enhance the muscular functions.[53] In accordance with the research by Bisset,[54] the lateral epicondylitis patients were given a Scapulothoracic mobilization and 19.8% of them showed higher grip strength after the manipulation. The groups treated with a spinal correction also showed less symptoms of sway-back posture by recovering the angle of spinal flexion.[55] In this paper, the subject showed remarkably less pain after the intervention. As the subject proceeded with the test, the subject showed less pain and maintained the intervention effects. The subject also maintained the intervention effects in the follow-up test given after two weeks.

This paper involves following limitations. First, this paper is a single subject research with limited number of subject and thus hard to generalize from the results. The further researches need to expand the subjects with test groups and control groups. Second, this paper could not limit the daily living activities of the subject which may influence on the dependent variables during the intervention period. The further researches need to extend the intervention period and prove the long-term effects on the elbow pain.

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