

ORIGINAL ARTICLE



The Effect of Controlling the Relaxation of Bony Landmarks Surrounding the Anterior Shoulder in Collegiate Wrestlers on Improving Shoulder Movement

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ABSTRACT

Background. Shoulder movement is an important factor for wrestlers. Because the shoulder has a complex structure, shortening of the muscles that move the shoulder joint is associated with injuries. Therefore, for wrestlers, shoulder movement is a factor that affects performance, so it is important to check mobility and keep it flexible. **Objectives.** The purpose of this study is to improve the angles of internal and external rotation of the shoulder joint by applying pressure to the bony landmarks where the related muscles are attached in order to make the wrestler's shoulder joint movement flexible. **Methods.** Forty-three male collegiate wrestling athletes were conditioned at bony landmarks where muscles involved in shoulder movement attach for 10 to 15 minutes before and after each match for three weeks. **Results.** As a result of comparing the range of motion before and after applying conditioning, it was found that there was a significant effect on improving mobility. Based on this, it is believed that a conditioning method that applies pressure to the landmark area of the bone may be effective. **Conclusion.** In this study, it was found that applying muscle compression and relaxation therapy based on bone landmarks had a significant effect on improving the internal rotation angle of the shoulder joint. The closer a muscle is to the tendon, the less blood it receives, and the tendon area is attached to the bone and endures muscle contraction and relaxation, so fatigue is thought to be high. Therefore, compression and rolling based on this area can help relieve accumulated fatigue, assuming there is no inflammation.

KEYWORDS: *Bony Landmark, Muscle Attachment, Shoulder Joint, Range of Motion.*

INTRODUCTION

Wrestling is one of the oldest sports in the world and can be categorized into Greco-Roman, freestyle, and women's wrestling (1). In all games, the starting position is standing or neutral on the ground and the common goal is to subdue the opponent by pressing both shoulders to the ground (2). Points can be earned by either getting the fall by pressing the opponent's shoulder for at least two seconds until it touches the ground or by

taking the opponent to the mat in a neutral position and gaining control. In the parterre position to defend against an opponent's attack, both hands and knees should be fixed to the floor and the torso should be kept as close to the floor as possible (3). When performing the fall and split positions, the shoulder joints must be mobile, and the elbow joints must be able to freely abduct and internal rotate (4). Therefore, in wrestling, the

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range of motion (ROM) of the shoulder joint is important to maintain the fall and parterre (5).

The shoulder joint, which must be suppressed to score points in wrestling, is made up of three bones and is moved by four rotator cuff muscles, including the supraspinatus, infraspinatus, pectoralis minor, and subscapularis, and their weakness and tension are fatal to the athlete (6). The above four muscles are attached to a large and specific area of the humeral head, and the fatigue that occurs in the muscle is transmitted to the attached bone through the tendon, and this area is called the bony landmark. Therefore, if the length and strength of the rotator cuff are insufficient, it becomes difficult to withstand external pressure, and the risk of injury to the greater and lesser tubercle of the humeral head increases (7). Wrestlers' shoulder injuries are related to the ROM of the shoulder joint, so not only the most commonly known supraspinatus injury, but also the nearby coracobrachialis, short head of biceps brachialis, and pectoralis minor muscles can be the cause of pain (8, 9). The supraspinatus attaches to the greater tubercle of the humerus and serves to rotate the shoulder joint. Therefore, if a tear occurs due to shortening, dislocation cannot be prevented, and the deltoid muscle and rotator cuff covering the humerus are also weakened (3, 4). Therefore, it can be said that the ROM and muscle condition near the shoulder joint affect a wrestler's use of techniques (10).

The incidence of upper extremity injuries in wrestlers during competition was approximately 2.5 times higher than during training, and the injury rate was inversely proportional to the athlete's experience (11). In a study analyzing the shoulder recovery process of athletes, 5.9% received surgical treatment, and 88.9% returned to the field by applying rehabilitation exercises or conditioning (12). A study applying rehabilitation exercises to shoulder injuries in wrestlers argued that rehabilitation for muscle injuries should aim to improve mobility and relieve fibrous tension in the injured area. Shoulder movement exercises have been reported to have a recovery effect by activating connective tissues such as muscles, tendons, and ligaments around the injured muscle (13, 14). In addition, many studies have been reported claiming that flexibility exercises and shoulder joint rotation exercises to improve internal rotation angle should be applied as a conservative treatment after a shoulder injury to prevent other injuries and that the above

rehabilitation exercises are necessary even after surgical treatment (14). This can be interpreted to mean that most injuries that occur during a game can be quickly returned to the field through non-surgical treatment (5, 15).

Muscle flexibility exercises, which are often mentioned as a way to prevent bicep brachialis injuries, require checking the ROM that can be used for each target and adjusting the intensity. In addition, because it is difficult to relax muscles with static stretching alone, dynamic stretching must be performed in parallel, and skill and time are required to increase muscle length (1, 16, 17). Muscle is one of the connective tissues and has a close relationship with muscle fibers. Therefore, there is a correlation between regeneration and recovery. Because force is transmitted to the tendon through the myotendinous junction during exercise, there is a high risk of damage during high-intensity exercise such as wrestling (18, 19). The shoulder movement test in FMS, a screening tool for underlying motor deficits to identify athletes at high risk for sports injuries, can examine shoulder joint extension, flexion, internal and external rotation. It is believed that objective data can be obtained when FMS is used for complex testing of shoulder joints with high mobility (20, 21).

Therefore, the purpose of this study was to examine the wrestling history, injury rate, and site of injury in wrestlers, and to determine how standard adjustments to bony landmarks of the shoulder joint affect mobility improvement.

MATERIALS AND METHODS

This study was conducted on 43 male student-athletes at Korea National Sport University who were registered as wrestlers with the Korea Sports Council and had more than 8 years of wrestling experience. Before applying conditioning, we conducted a preliminary investigation into the player's career, injured area, and current status, and performed an Apley scratch test before and after conditioning to confirm changes in shoulder range of motion. Conditioning is applied in the form of pressure applied to the greater and lesser tuberosities of the humerus and coronal process of the scapula for approximately 15 minutes before and after daily training.

Conditioning Therapy. The treatment applied to athletes involves compressing the greater and lesser tubercle of the humerus, where the rotator cuff is attached, and the coronal

process of the scapula, where the coracobrachialis and biceps brachii muscles are attached. The bony landmark area on the bone mentioned is the area where the muscle attaches to the bone and the point close to the tendon. All conditioning sessions last a total of 10-15 minutes, with breaks taken if pain occurs. This relaxation method was applied before and after training for three weeks.

Functional Movement Screen Test. To identify athletes at high risk for sports injuries, we determine the range of motion of the left and right shoulders using the Apley scratch test, a tool to screen for underlying motor deficits in active populations (18-20). This test measures the distance between the two hands while the subject rotates the shoulder on the side to be tested inward, places the back of the hand on the back of the hand, and rotates the other hand behind the head to fix the chest. During the test, the subject must be able to position the body within the line of gravity without experiencing pain. This type of reaching test has been described as a tool to measure glenohumeral joint mobility through functional shoulder movements (21).

Statistical Methods. For each subject, the presence or absence of asymmetry is defined for each variable if the left-right difference is greater than 10. This threshold follows previous findings in the literature defining the normal amount of asymmetry in left-right ROM in overhead athletes. Measurement errors associated with the amount of rotation associated with bone morphological changes in overhead athletes were selected using a standard goniometer. For the shoulder movement test results, the probability of

significance was confirmed using a T-test using the SPSS program to compare the differences after total collapse ($p < 0.05^*$, $p < 0.01^{**}$, $p < 0.005^{***}$) (22-25).

RESULTS

The average age of the college athletes who were the subjects of this study was 21.5 years and their playing experience was 8.5 years. The average number of injuries experienced during a player's career was approximately 4.86, and the severity of the injuries varied, so all players had a high risk of recurrence. Some players experienced more than five injuries in a season (Table 1).

In a test to check the flexibility of the shoulder joint, when the right arm was internally rotated before the procedure, the distance between the hands was measured at 16.14 ± 1.40 cm, and when the left arm was internally rotated, the distance between the hands was measured at 19.57 ± 1.33 cm for the fist.

As a result of re-measurement after treatment for 10 to 15 minutes, 5 times a week for 3 weeks, when the right arm was internally rotated, the distance between the fists decreased by about 7 cm to 9.14 ± 1.26 cm. This can be seen to be a significant number in the correlation test ($p = 0.001^{***}$).

As a result of the re-measurement of the internal rotation of the left arm, the distance between the hands decreased by about 3 cm to 16.34 ± 1.25 . As a result of comparing the distance between both hands through the Apley scratch test before and after conditioning, a significant result was found in the correlation test (Table 2).

Table 1. Basic information on the research subject

	Age	Player career	Time of injury
Participants	21.58 ± 0.15	8.51 ± 0.17	4.86 ± 0.42

Table 2. Distance measurement results between both hands before and after treatment

Internal rotation	Pre-test distance (cm)	Post-test distance (cm)	P-value
L	16.14 ± 1.40	9.14 ± 1.26	0.000^{***}
R	19.57 ± 1.33	16.34 ± 1.25	0.001^{***}

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.005^{***}$

DISCUSSION

In this study, the reasons for applying the internal rotation test as a method of checking the presence or absence of pain in athletes and the area of pain are as follows. Previous studies have

shown that wrestlers are at risk of injury due to posterior displacement of the humerus due to external pressure from the opponent and that the cause of the injury is damage to the rotator cuff, pectoralis minor, biceps brachii, and brachialis. In

studies of related muscle injuries, a 90° forward flexion stance combined with horizontal adduction and internal rotation has often been applied as a method to identify muscle-related shoulder injuries (26).

Common symptoms of parascapular muscle injury include posterior joint line tenderness, posterior humeral head displacement, posterior stress, and pain with exercise testing (27). Previous studies used methods such as rotator cuff strengthening exercises and stretching to prevent or rehabilitate injuries, but it was difficult to confirm the effectiveness or sustainability of the methods. This is believed to be due to an inability to accurately identify the area where conditioning should be applied. According to anatomical studies, it has been reported that relaxing and strengthening the muscles attached to the coronoid process, as in this study, is effective when setting landmarks for areas where conditioning should be applied (28). Depending on the area where pain occurs, muscles with a high risk of damage can be predicted, and a decrease in ROM can be confirmed depending on the damaged muscle. Therefore, conditioning was applied through compression and rolling to the bony landmark area where the muscles involved in the stability and movement of the shoulder joint are attached (29).

Therefore, preventing shoulder injuries in wrestlers requires testing internal and external rotation ranges and applying conditioning to bony landmarks. The treatment sites used in this study were the greater and lesser tubercle of the humerus and the coracoid process of the scapula. Additionally, based on these bony landmarks, it is believed that relaxation of the deltoid space of the shoulder will be very effective (30). The present study has a research design that applies daily treatment to a sports environment where training occurs every day rather than just a few minutes of treatment several times a week. Although continuous treatment was limited due to field training and participation in competitions, it was evaluated that meaningful results were achieved in just three weeks (31). As it is an exercise that requires momentary strong force, firmness rather than muscle flexibility is emphasized, and although the need for relaxation is known, this problem appears to have arisen because the method or degree cannot be specified. This study was conducted for 3 weeks but considering that it was applied before and after daily training, it

cannot be considered a short experimental period (32). It is considered an essential conditioning method not only for wrestlers, but also for weightlifters who need instantaneous and large strength, archery where shoulder movement is important, and dance trainees who need to express flexible movements of the upper and lower body. In this study, the reasons for applying the internal rotation test as a method of checking the presence or absence of pain in athletes and the area of pain are as follows (30, 33).

In wrestlers, external pressure from an opponent can cause posterior displacement of the humerus, resulting in damage to the rotator cuff, pectoralis minor, biceps brachii, and brachialis, which is reported to be the biggest cause of injury. In previous studies, a 90° forward flexion stance combined with horizontal adduction and internal rotation was often applied as a method to identify muscle-related shoulder injuries (32, 33). Common symptoms of parascapular muscle injury include posterior joint line tenderness, posterior humeral head displacement, posterior stress, and pain with exercise testing. It was predicted that the likelihood of damage would be high depending on where the pain occurred, and this was thought to be related to a decrease in ROM. Therefore, treatment is applied to the landmark area of the bone where the surrounding muscles are attached.

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CONCLUSION

When the muscles that move the shoulder joint apply pressure to the tendon area attached to the bone, the movement of the shoulder joint

becomes flexible. Due to the nature of the tendon, its blood supply is low, so flexibility due to compression is not expected to last long, and dynamic stretching and static stretching should be applied together. Stretching methods using motion may have limitations in stretching all the muscles around the shoulder, so this treatment method of compressing the muscle attachment area may be helpful in improving the flexibility of the shoulder joint.

APPLICABLE REMARKS

- Relaxation of muscles involved in shoulder joint movement and stability was found to be effective in relieving pain and improving mobility, and the compression area for muscle relaxation was said to be more effective when the bony landmark was used as the standard. If this conditioning method is applied to other sports that require overpowering an opponent or using strong shoulder strength, it is believed that significant effects can be seen, and it should be noted that the timing, time, and number of applications must be taken into consideration.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Je-Hun Lee, Jin-Kuk Baek. Acquisition of data: Na-Young Yoon. Analysis and interpretation of data: Na-Young Yoon, Je-Hun Lee. Drafting the manuscript: Jin-Kuk Baek. Critical revision of the manuscript for important intellectual content: Je-Hun Lee. Statistical analysis: Na-Young Yoon. Administrative, technical, and material support: Je-Hun Lee, Jin-Kuk Baek. Study supervision: Na-Young Yoon.

CONFLICT OF INTEREST

The authors mention that there is no "Conflict of Interest" in this study.

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