RESEARCH ARTICLE

A Comparison of Glenohumeral Internal and External Range of Motion and Rotation Strength in healthy and Individuals with Recurrent Anterior Instability

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Abstract

Background: The glenohumeral joint becomes dislocated more than any other major joint because it maintains a wide range of motion and its stability is inherently weak. The most common complication following acute initial shoulder dislocation is recurrent dislocation or chronic instability. Imbalance of strength and range of motion in individuals with anterior dislocation can be a contributing factor in recurrent dislocation as well.

Methods: This case-control study consisted of 24 individuals with a mean age of 24.29±4.33 years, and a mean dislocation rate of 5.37±3.62 times. Isometric cuff strength was measured using a handheld dynamometer and for range of motion, the Leighton flexometer was used in internal and external rotational motions of both upper extremities. Independent t-test was used for data analysis.

Results: The internal and external range of motion of the injured glenohumeral joint was lower than the uninjured joint ($P<0.001$). Similarly, the internal and external rotation strength of the injured joint was lower than the uninjured joint ($P<0.001$).

Conclusions: According to previous data, imbalance of strength and range of motion in individuals with anterior shoulder dislocation can be a contributing factor in long-term disability and increased recurrent dislocation and our finding confirm decreased range of motion and strength in our patients. Hence, proper exercise and rehabilitation plans need to be developed for those suffering from this complication.

Key words: Anterior shoulder instability, Glenohumeral joint, Range of motion, Strength

Introduction

Almost 50% of major joint dislocations occur in the glenohumeral joint because this joint maintains a wide range of motion and has weak inherent bone stability. The most common complication following acute initial shoulder dislocation is recurrent dislocation or chronic instability (1). Since the majority of glenohumeral joint instabilities occur as anterior or anterior-inferior dislocations, addressing their mechanism is essential (2). Anterior glenohumeral dislocation is commonly caused by external rotation-abduction mechanism (3).

The glenohumeral joint maintains the widest range of motion among all the body joints and this requires desirable efficiency of shoulder stabilizer and rotator cuff muscles, which are naturally responsible for retaining the head of the humerus in place in the glenoid fossa while carrying out functional activities (4). Any disorders in the balance and harmony of shoulder and humerus motions negatively influence the rotator cuff biomechanics and increase the possibility of shoulder injury (5).

A disorder in internal and external rotation strength of the shoulder plays an important role in shoulder injuries. The imbalance of the internal/external rotation strength ratio may cause the arm's rotation angle to change while the arm is lifted that may be followed by a disordered shoulder movement pattern (6). Changes in

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Figure 1 and 2. Measuring the internal rotation range of motion of the glenohumeral joint.

Figure 3. Measuring the external rotation range of motion of the glenohumeral joint.

the range of motion will cause uneven and asymmetric muscular growth due to excessive exercising; targeting specific muscle groups, and as a result, increases the risk of injury in athletes.

Considering the prevalence of shoulder dislocation, there is a need for effective strategies in decreasing recurrent dislocations. Due to pain, limitation of motion, and disability of the shoulder, this problem disrupts daily activities, especially in younger athletes. The present study aimed at comparing the internal and external range of motion and rotation strength of the glenohumeral joint in individuals with recurrent anterior dislocation.

Materials and Methods

This was a case-control study that included a statistical population of 24 individuals who were selected by simple sampling method. All of the individuals presented with recurrent anterior glenohumeral joint dislocation and so were referred to our research team. All the patients signed a written informed consent form to participate in the study. They were physically examined by an orthopedic surgeon regarding any history of glenohumeral joint surgery, and those with a history of shoulder surgery at the time of the study were excluded. This study was approved by the Ethical Committee for Research of the Kerman University of Medical Sciences.

Method of Measurement

A trial course was initially conducted to familiarize the participants with the test and the correct testing performance. After measuring the heights and body weights of the subjects, testing initiated. This study used a Leighton flexometer to measure range of motion and a dynamometer to measure strength.

Measuring the internal and external rotation range of motion of the glenohumeral joint

Each participant stood with their back against the pillar and cloth straps were tied across their chest, head, and hips to prevent movement. The studied arm was abducted to 90º and the elbow was flexed to 90º. The opposite arm was positioned along the body, and the Leighton flexometer (Jtech Medical, UK) was fixated on the middle of the outer forearm (Figure 1). To measure internal rotation range of motion, the participant was asked to move the forearm throughout the range of motion; the dial of the flexometer locked at full extent of down and backward motion. Then the subject was asked to take a resting position while the observed value was recorded. When commencing measurement, the distal end of the arm was retained to 90º abduction and 90º flexion (Figure 2).

To measure external rotation range of motion, the participant was asked to move the forearm throughout up and backward range of motion and then the dial locked at full extent. Then, the subject was asked to take a resting position and the observed value was recorded. When commencing measurement, the distal end of the arm was retained at 90º abduction and 90º flexion (Figure 3).

Measuring the internal rotation strength of the

Figure 4. Measuring the internal rotation strength of the glenohumeral joint.

Figure 5. Measuring the external rotation strength of glenohumeral joint.

Table 1. Comparison of internal and external ROM and strength in healthy and injured shoulders.

Variable	Injured		Uninjured		*P* value
	No.	Mean	No.	Mean	
Internal rotation range of motion	24	69.00 ± 6.62	24	81.53 ± 7.03	<0.001
External rotation range of motion	24	84.45 ± 5.86	24	104.54 ± 11.09	<0.001
Internal rotation strength	24	8.88 ± 1.53	24	11.42 ± 2.58	<0.001
External rotation strength	24	8.70 ± 1.96	24	10.56 ± 2.21	<0.001

glenohumeral joint

The subject lied prone on a table with a pillow placed under the examined arm. The arm was abducted to 90º and the elbow flexed to 90º. The subject's head was turned towards the examined arm. To measure internal rotation strength, the examiner placed one hand directly above the subject's shoulder, and with the other hand located the dynamometer behind the anteroinferior forearm. The participant was asked to apply maximal force for about 6-7 seconds. This test was conducted for a second time with a 30 sec interval (Figure 4). To measure external rotation strength the examiner located the dynamometer behind the posteroinferior forearm. The participant was asked to apply maximal force for about 6-7 seconds. This test was conducted for a second time with a 30 sec interval (Figure 5).

Results

Internal rotation range of motion values for the injured and uninjured glenohumeral joints were 69.00±6.62º and 81.53±7.03º, respectively. External rotation range of motion values for the injured and uninjured glenohumeral joints were 84.45±5.86º and 104.54±11.09º, respectively (Figure 6). Also, values for internal rotation strength of injured and uninjured glenohumeral joints were 8.88±1.53 and 11.42±2.58 Newton, respectively. Values for external rotation strength of injured and uninjured glenohumeral joints were 8.7±1.96 and 10.56±2.21 Newton, respectively (Figure 7).

As shown in Table 1, the results indicate that there is a significant difference between the internal and external rotational range of motion of the injured and uninjured glenohumeral joint (*P*<0.001). Similarly, there is a significant difference between the internal and external rotation strength of the injured and uninjured glenohumeral joint (*P*<0.001).

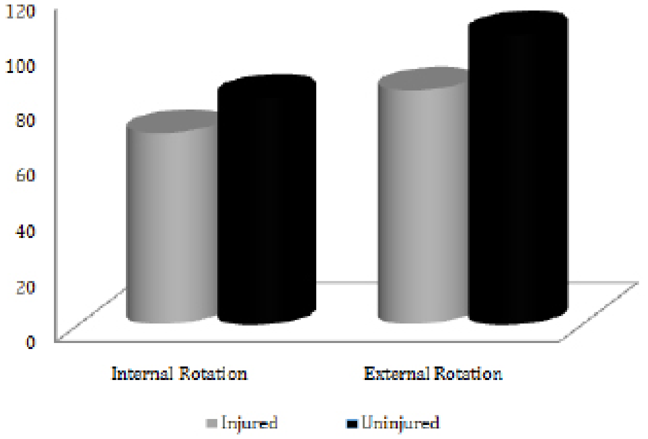

Figure 6. Internal and external range of motion in injured and uninjured shoulder.

Discussion

This study measured differences of internal and external rotation range of motion and strength between injured and non-injured shoulders in patients with recurrent shoulder instability. Results of this study revealed affected shoulders had decreased range of motion and strength, which are consistent with those reported by Gabriel., who proposed that internal rotation range of motion in handball players with shoulder pain in the dominant hand was significantly lower compared to those without shoulder pain (7). Our results also match the results of Ruotolo, indicating that the changes of internal rotation range of motion in the painful and painless groups were significant (8).

According to the results, internal rotation strength values of the injured and uninjured shoulder are significantly different, which is consistent with the findings reported by Jan et al., who studied subjects with shoulder impingement (9). They maintained that cuff strength was lower in the injured rather than the uninjured shoulder. Similarly, findings of the current study match those of Michelle et al., who reported internal and external rotation strength was lower in

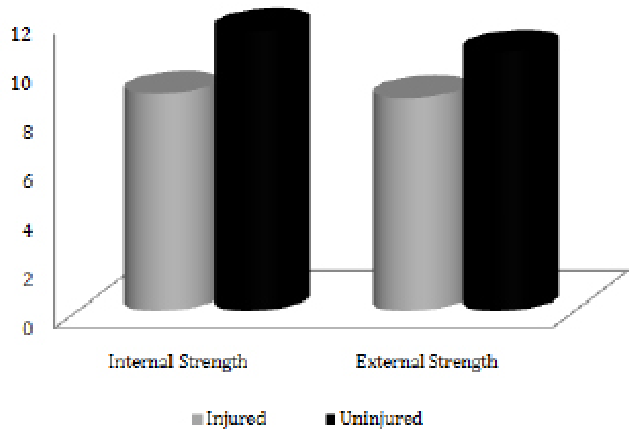

Figure 7. Internal and external strength in injured and uninjured shoulder.

subjects with anterior dislocation (10).

In uninjured individuals, bilateral comparisons are mostly employed to identify muscle strength deficiencies. Every joint, in general, is required to maintain a desirable range of motion for efficient force transfer to accelerate, decelerate, and stabilize the interconnected joints of the body and produce the desired movements (11). A proper balance between agonist and antagonist muscle groups leads to dynamic stabilization of the inherently unstable shoulder joint (12). The imbalance of these muscles causes changes in arthrokinematics and movement impairments, which may eventually lead to structural changes (13). Muscular imbalance occurs when agonist/antagonist length or strength prevents normal functions. Muscular imbalance may occur as a response to adaptation for movement patterns, which includes strength or flexibility imbalance of antagonist muscle groups (7). Muscular imbalance may be indistinct because many people suffer from painless imbalance, which ultimately causes joint disability, changes in pattern of movement, and eventually grow painful. Some injuries lead to muscular imbalance, while some other injuries may result from it. Shoulder concussion is associated with rotator cuff muscular imbalance and shoulder stabilizers. Unstable shoulder is also associated with muscular imbalance. As reported by prospective studies, muscular imbalance is associated with injury status, although, specific injuries may change either of or both length and strength of imbalanced muscles (14).

The results of the present study showed that the imbalance of strength and range of motion, introduced as a traumatic agent in many studies, can be also presented in individuals with anterior dislocation as a factor in increasing long term injury and dislocation recurrence.

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