

## Effects of Soft Tissue Massage of the Posterior Deltoid Muscle on Shoulder Horizontal Adduction

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### Abstract

Stiffness of the posterior deltoid is as a causative factor in the limited range of glenohumeral horizontal adduction and various other shoulder pathologies including shoulder impingement syndrome, frozen shoulder, and humerus anterior glide syndrome. The purpose of this study was to compare the effects of two techniques (soft tissue massage and cross-body stretch) on increasing the range of horizontal adduction. Thirty-two subjects with a 10° or greater difference between the right and left sides in horizontal adduction were selected. Sixteen subjects from each group were allocated randomly. Interventions were applied on six occasions for 2 weeks, and the range of horizontal adduction was measured using an inclinometer at pre-and post-intervention. A 2×2 analysis of variance (intervention×time) was used to compare the effects of the two techniques. In the soft tissue massage group, the angle of horizontal adduction significantly increased compared with the cross-body stretch group. These findings indicate that the soft tissue massage of the posterior deltoid muscle is a more effective method to increase the flexibility of the glenohumeral horizontal adduction.

**Key Words:** Cross-body stretch; Glenohumeral horizontal adduction; Posterior deltoid; Soft tissue massage.

### Introduction

Stiffness of the posterior deltoid, including the posterior muscles and capsule is as a causative factor in shoulder impingement syndrome, frozen shoulder by the decreasing subacromial space (Ludewig and Cook, 2002; Reeves, 1975; Tyler et al, 2000). The passive range of motion of glenohumeral horizontal adduction is commonly used to measure the length or stiffness of the posterior deltoid muscle. And a glenohumeral horizontal adduction exercise is often performed and prescribed to increase the flexibility of the posterior glenohumeral structures

(Muraki et al, 2006). Additionally, glenohumeral horizontal adduction is frequently used to identify the humeral anterior gliding syndrome, which is caused by insufficient posterior glide during overhead motions and horizontal adduction (Caldwell et al, 2007; Sahrmann, 2002). The flexibility of the posterior shoulder structure, including the posterior deltoid is important prior to initiating strengthening exercises for the shoulder joint (Morrison et al, 1997).

Numerous techniques have been applied to increase the flexibility of the posterior shoulder capsule and muscles. Previous studies suggested that a posterior glide of the humeral head, towel stretch, sleeper stretch, and

cross-body stretch are effective techniques to decrease posterior glenohumeral stiffness (Bach and Goldberg, 2006; Johnson et al, 2007; Weldon and Richardson, 2001). McClure et al (2007) reported that cross-body stretch was the most effective of these techniques.

Recently, massage of the infraspinatus and teres minor muscles was used to decrease posterior shoulder stiffness and reduce pain in patients with glenohumeral impingement syndrome. In this regard, Poser and Casonato (2008) reported that massage can be used to treat patients with impingement syndrome without stressing the glenohumeral joint, compared to joint gliding technique.

Hung et al (2010) reported that, among posterior muscles, stiffness of the posterior deltoid muscle has a higher correlation with increased posterior shoulder stiffness than does stiffness of the infraspinatus and teres minor muscles. Excessive and overuse activity of the posterior deltoid instead of the infraspinatus and teres minor contribute to an increase humeral anterior gliding and stiffness of posterior deltoid (Caldwell et al, 2007; Mueller and Maluf, 2002; Sahrman 2002).

However, none of these studies investigated the effects of the soft tissue massage of the posterior deltoid muscle with regard to increasing the angle of shoulder horizontal adduction. Examining these effects will provide a useful technique to reduce stiffness of the posterior deltoid.

The purpose of the present study was to investigate the effects of soft tissue massage of the posterior deltoid on the flexibility of glenohumeral horizontal adduction. We hypothesized that soft tissue massage of the posterior deltoid muscle would provide a more effective method for improving the range of horizontal adduction compared with the conventional cross-body stretch technique.

## Methods

### Subjects

Thirty-two subjects with a 10° or greater differ-

ence in glenohumeral horizontal adduction between the right and left sides were selected from among 50 students in the department of physical therapy, Yonsei University, Korea (Table 1). These 32 subjects were allocated randomly to two groups, soft tissue massage group (N=16; men=8, women=8) and cross-body stretch group (N=16; men=8, women=8). In the previous study, the intratester and intertester reliability of measurement of horizontal adduction using the inclinometer resulted in ICC and SEM values of .93 and 1.64° and .91 and 1.71°, respectively (Laudner et al, 2006). The exclusion criterias were past or present shoulder surgery, shoulder symptoms, and glenohumeral joint pain above 5/10 using a visual analog scale (VAS) in centimeters. Prior to the study, the principal investigator explained all the procedures in detail to the subjects, and all subjects signed an informed written consent form for participation in the study.

### Measurement of Glenohumeral Horizontal Adduction

For the measurement of horizontal adduction, the participants lay supine on the therapeutic table while the tester stood at the end of the table near the head of the subject and positioned the test shoulder and elbow at 90° of abduction and flexion. The tester stabilized the scapular lateral border by providing a posterior directed force (toward the table) to restrict scapular protraction, rotation, and abduction (Figure 1). An inclinometer was used to measure the range of glenohumeral horizontal adduction. The

**Table 1.** General characteristics of subjects (N=32)

	Soft tissue massage	Cross-body stretch
Men/Women	n <sub>1</sub> =16 (8/8)	n <sub>2</sub> =16 (8/8)
Height (cm)	168.6±8.2 <sup>a</sup>	168.4±7.7
Body mass (kg)	62.2±10.0	61.4±8.3
Difference of HA(°) <sup>b</sup>	23.8±9.4	23.1±6.6

<sup>a</sup>Mean±SD, <sup>b</sup>Difference of horizontal adduction between the right and left sides.

HA: horizontal adduction.



**Figure 1.** Measurement of glenohumeral horizontal adduction.

tester held the distal portion of the subject's elbow, and passively moved the humerus into glenohumeral horizontal adduction. When the humerus was near the end range of horizontal adduction, the assistant tester measured the angle of horizontal adduction using the inclinometer. To measure glenohumeral horizontal adduction, the inclinometer was aligned with the middle of the humerus. A measurement of 0° of horizontal adduction was perpendicular to the plane of the examination table. Each subject completed three trials, and the average of the three trials was used for data analysis (Laudner et al, 2006). The range of horizontal adduction was measured at the initiation (pre-intervention) and completion of the study (post-intervention). Post-intervention was performed 2 weeks after initial intervention.

### Intervention

Soft tissue massage on the posterior deltoid muscle or cross-body stretch was performed based on group

assignment. The intervention was repeated six times over a 2-week period. Two interventions consisted of 10 sessions (one session was 20 seconds of soft tissue massage or of cross-body stretch and 10 seconds rest) and took 5 minutes. The subjects did not receive any other massage, stretching, and treatment related to shoulder area during the intervention period.

#### A. Soft Tissue Massage

To treat only the posterior deltoid muscle, the patient was positioned side-lying on the side opposite the area being massaged. The scapula of the test shoulder was stabilized in a fully retracted position by tester's hand. The test side shoulder and elbow were placed in 90° of flexion with humerus in neutral rotation. The subject was asked to hold and fix his/her elbow with opposite hand (Figure 2a). The tester's palm with 90° of thumb extension was placed on the acromial end of the subject's posterior deltoid muscle (Figure 2b). For the massage, the subject was asked to slowly rotate the trunk backward while the principal investigator pushed firmly down with the tester's palm on the posterior deltoid. The technique of massage was the modified deep gliding for myofascial release (Sherman et al, 2006). The force of the press was controlled according to the subjective response of the subject (Figure 2c).

#### B. Cross-body Stretch

The cross-body stretch was performed by the subject. The subject was asked to pull the humerus across the body into horizontal using the opposite arm in the standing position (Figure 3) (McClure, 2007).



**Figure 2.** Soft tissue massage on the posterior deltoid.



Figure 3. Cross-body stretch.

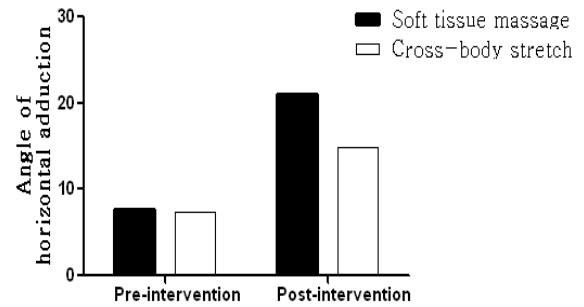


Figure 4. Change of horizontal adduction between pre-and post-intervention period.

### Statistical Analysis

A 2×2 analysis of variance was used to compare the effects of the soft tissue massage and cross-body stretch interventions, with one between-subjects factor (type of interventions) and one within-subjects factor (pre and post-intervention). The level of statistical significance set at .05. All data were analyzed using SPSS 12.0 software.

### Results

We observed a significant difference in the change in the horizontal adduction angle between two groups ( $p < .01$ ). A significant main effects were observed for both intervention and time ( $p < .01$ ). In addition, we observed a significant interaction between intervention type and time ( $p < .01$ ). The angle of the horizontal adduction increased significantly more in the soft tissue massage group compared with the cross-body stretch group (Table 2) (Figure 4).

### Discussion

The measurement of glenohumeral horizontal adduction is frequently used assess posterior glenohumeral joint stiffness in patients with impingement syndrome, or frozen shoulder (Caldwell et al, 2007; Muraki et al, 2006; Sahrmann, 2002; Tyler et al, 2000). McClure et al (2007) reported that the cross-body stretch is the most effective way to decrease posterior glenohumeral joint stiffness. To our knowledge, the present study is the first to confirm the beneficial effects of soft tissue massage of the posterior deltoid muscle rather than the cross-body stretch joint for the reduction of posterior glenohumeral joint stiffness. Comparison of pre-intervention and post-intervention measurements showed that soft-tissue massage was more effective in increasing the range of horizontal adduction than was the cross-body stretch technique.

There are several possible explanations for this findings. First, soft tissue massage can selectively

Table 2. Range of horizontal adduction at pre- and post-intervention (N=32)

	Pre-intervention*(a)	Post-intervention*(b)	Mean of difference (b-a)
Soft tissue massage* (n <sub>1</sub> =16)	9.69±5.62 <sup>a</sup>	35.94±6.12	26.25±.50
Cross-body stretch* (n <sub>2</sub> =16)	9.38±5.44	24.69±4.99	15.31±.45

<sup>a</sup>Mean±SD, \*Significant increase ( $p < .01$ ) between periods for noted measurement for each intervention group.

release posterior deltoid muscle, whereas cross-body stretch cannot selectively isolate the restriction originating in the glenohumeral joint capsule or posterior muscles (Gerber et al, 2003; Grossman et al, 2005; Poser and Casonato, 2008). The effective stabilization of the scapula was emphasized, allowing a decrease in stiffness of the posterior glenohumeral joint during horizontal adduction (Caldwell et al, 2007; Pappas et al, 1985; Sahrman, 2002). In the absence of stabilization of the scapula, the muscle fiber or glenohumeral joint capsule may not be stretched selectively due to an insufficient fixation of the proximal part of the posterior deltoid or glenohumeral joint capsule during horizontal adduction. During the soft tissue massage in our study, the scapula of the subjects were stabilized by the tester's hand selectively decreasing the stiffness of the posterior deltoid muscle. The scapula is not sufficiently stabilized during the cross-body stretch.

Second, soft tissue massage focused on muscle, particularly the posterior deltoid rather than joint capsule. Poser and Casonato (2008) highlighted that massaging the infraspinatus and teres minor muscles can result in a 20° improvement in internal shoulder rotation. This improvement is comparable to other techniques that focus on the joint capsule, such as cross-body stretch and joint mobilization (McClure et al, 2007; Vermeulen et al, 2000). This means that selectively massaging the posterior deltoid can increase range of internal rotation without stressing the joint capsule as the stiffness of posterior deltoid muscle rather than the infraspinatus and teres minor, play an important role in the stiffness of the posterior shoulder (Hung et al, 2010).

Third, the position of soft tissues massage effectively increased the range of horizontal adduction and stretch or release of the posterior deltoid muscle. The actions of posterior deltoid muscle include shoulder horizontal abduction and external rotation (Kisner and Colby, 2007; Sahrman, 2002). The horizontal adduction position has been used to stretch the posterior portion of the deltoid, because this position makes a

tensed posterior deltoid muscle as the shoulder horizontal abductor (Wilk et al, 2002; Zakas et al, 2003). In our study, the subjects stabilized the test shoulder in the internal rotation position by holding the elbow preventing the external rotation of the shoulder during the soft tissue massage. Conversely, the starting position of cross body stretch was with the shoulder in neutral rotation, however shoulder is gradually externally rotated during this stretch (McClure et al, 2007).

The present study is not without its limitations. First, we recruited only healthy young students, hence, our findings cannot be generalized to subjects of all age. Therefore, young and old patients with glenohumeral impingement syndrome or humerus anterior glide syndrome should be investigated. Second, we could not provide a standard intensity of massage to all subjects as the intensity was determined by the subject's response.

## Conclusion

We conclude that soft tissue massage on the posterior deltoid muscle is a more effective technique than the cross-body stretch to decrease posterior glenohumeral joint stiffness and increase the range of horizontal adduction. Soft-tissue massage applied to the posterior deltoid muscle can thus be used as an effective technique to improve glenohumeral horizontal adduction.

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