ORIGINAL ARTICLE

IJPHY

A PROPOSED NOVEL INHIBITOR STRETCHING PROCEDURE FOR POSTERIOR SHOULDER TIGHTNESS

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ABSTRACT

Background: Posterior shoulder tightness has been proposed to contribute to or cause a myriad of shoulder conditions. The tightness of the posteroinferior capsule and the teres minor and infraspinatus muscles of the posterior cuff has been hypothesized to cause osteokinematic [e.g., limited glenohumeral (GH) internal rotation] and arthrokinematic dysfunctions (e.g., decentralization of the humeral head). A number of interventions have been successful in the restoration of or at least improvement in posterior shoulder flexibility including joint mobilizations (e.g., posterior glide) and posterior cuff stretches. The two most common posterior cuff stretches, the sleeper stretch and the cross-body stretch, mimic the position of two common impingement Orthopaedic provocation tests. Despite the success of stretching to help optimize tissue extensibility to help prevent injuries, these stretches have been reported to cause pain in some symptomatic subjects. For these reasons, the authors propose creating an alternate posterior shoulder self-stretching technique that facilitates the inhibition of the target region.

Aim: Therefore, this paper aims to introduce a novel stretching protocol that utilizes a form of reflex inhibition to help relax the muscle during the stretching procedure to increase efficiency and reduce pain during the stretching maneuver.

Underlying Principles for the Proposed Stretching Maneuver: This novel stretch is an active-assisted maneuver using a form of reciprocal inhibition. The authors propose that muscular inhibition through Ia afferents can be applied in a more global manner by muscle contraction of the anatomically remote posterolateral hip cuff musculature (gluteus maximus and medius) to inhibit the target muscles of the posterior rotator cuff of the scapulohumeral joint (infraspinatus and teres minor). This novel inhibitory stretching technique is referred to as Inhibition Stretching (IS), and the specific technique utilized in this study is the Clam Shell Bridging Maneuver. This technique is recommended for overhead athletes with and without shoulder pain and limited GH IR.

Summary: The authors have proposed a novel stretching procedure, the Clam Shell Bridging Maneuver, that is hypothesized to reduce the muscles guarding, and resistance of the shoulder girdle during stretching and also position the athlete in a way that helps minimizes pain and impingement during the stretch while still providing stabilization to the scapula.

Keywords: Proprioceptive Neuromuscular Facilitation, Stretching, Posterior Capsule, Internal Rotation, Shoulder.

Received 08th October 2019, accepted 05th December 2019, published 09th December 2019

10.15621/ijphy/2019/v6i6/190225

www.ijphy.org

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INTRODUCTION

Posterior shoulder tightness has been proposed to contribute to or cause a myriad of shoulder conditions including subacromial pain syndrome (SAPS), glenohumeral internal rotation deficit (GIRD), rotator cuff tears, and labral lesions [1-8]. More specifically, tightness of the posteroinferior capsule and the teres minor and infraspinatus muscles of the posterior cuff has been hypothesized to cause osteokinematic [e.g., limited glenohumeral (GH) internal rotation] and arthrokinematic dysfunctions (e.g., decentralization of the humeral head) [8]. Tightness or shortening of these posteroinferior (PI) structures have been suggested to cause the PI capsuloligamentous complex to lose its hammock-like effect resulting in more significant pressure on the PI aspect of the head of the humerus thus causing it to migrate in an anterosuperior direction towards the coracoid process, the coracoacromial ligament and the 2 o'clock position of the glenoid labrum during arm elevation [8-11]. This anterosuperior translation has been proposed to result in a reduction in the acromiohumeral distance (AHD), potentially causing compression and impingement of the supraspinatus and subscapular muscles as well as the long head of biceps tendon and subacromial bursa [12-13]. In addition to limited GH internal rotation (IR), the anterosuperior humeral head migration may limit shoulder flexion and horizontal adduction [12].

A loss of shoulder horizontal adduction has been reported as a predictor of injury rate and pathological subacromial impingement [14]. Thus, there is ample evidence that tightness of the posterior shoulder structures is a risk factor for developing numerous shoulder conditions and interventions directed at remediating this tissue restriction would be advantageous, especially in overhead athletes and workers.

It has been proposed that a stretching program that focuses on the posterior shoulder, until adequate flexibility has been achieved, should be initiated before starting a strengthening program [15]. A number of interventions have been successful in the restoration of or at least improvement in posterior shoulder flexibility, including joint mobilizations (e.g., posterior glide) and posterior cuff stretches [16]. Numerous stretches have been proposed and studied with the two most commonly used being the Sleeper Stretch (SS) and the Cross-body Stretch (CBS) [8, 16-20]. The CBS has been scrutinized because the CBS was originally performed in sitting or standing, which did not adequately stabilize the scapula thus not focusing the stretch to the posterior shoulder structures [7, 16-17]. More recently, both of these stretches have been modified (m) to position the patient in side-lying to better stabilize the scapula through body weight, mSS, and mCBS respectively [21]. In a recent study, it was determined that stabilizing the scapula during an across-body stretching procedure was more effective in increasing the extensibility of the posterior shoulder structures and increasing the IR range of motion [22]. McClure et al (2007) compared the mSS to the CBS and found a slightly greater improvement in Shoulder IR in the CAS group; however they cautioned that the subjects were asymptomatic and the sample size was too small to preclude statistical differences between the two stretches.[18] They did attribute the changes in improved motion to length changes of the posterior capsule, periarticular tissues, posterior cuff muscles [18]. However, it is essential to remember that there is a subpopulation of throwing athletes that have limited shoulder IR due to bony tissue adaptations, which would not respond to stretching; the SS may be detrimental for these individuals [17].

Despite the success of stretching to help optimize tissue extensibility to help prevent injuries [21], these stretches have been reported to cause pain in some symptomatic subjects [17,23]. Also, the SS and CBS both mimic the position and maneuver of two orthopedic shoulder special tests for impingement - the Hawkins-Kennedy and the Cross-body Adduction, respectively [22]. In a recent systematic review, Mine K et al. suggested that CBS may be less painful than the mSS [23]. For these reasons, the authors propose creating an alternate posterior shoulder self-stretching technique that facilitates inhibition of the target region. Therefore, the aim of this paper is to introduce a novel stretching protocol that utilizes a form of reflex inhibition to help relax the muscle during the stretching procedure to increase efficiency and reduce pain during the stretching maneuver.

Underlying Principles for Proposed Stretch – Inhibitory Stretch (IS)

This novel stretching technique combines neural activity modulation maneuvers described by E. Jendrassik [24] and H. Kabet & M. Knott [25]. In the late 19th century (1885), Ero Jendrassik, a Hungarian physician, describes a reflexic inhibition technique by employing a remote voluntary muscle contraction to enhance the amplitude of tendon reflexes by preventing the individual from consciously influencing the movement [24]. The mechanism by which the Jendrassik maneuver (JM) influences the reflex is through presynaptic inhibition of the alpha motorneurons by Ia afferents [24]. An example of the JM includes contraction of facial and upper extremity musculature (e.g., clench teeth and isometrically attempting to pull interlocked fingers apart) while simultaneously eliciting the patellar tendon reflex. In general, a maneuver that has an excitatory influence on agonistic alpha motor neurons will have an inhibitory effect on the alpha motor neurons of the antagonist, a form of reciprocal inhibition.

In the 1940s, Herman Kabet and Maggie Knott developed Proprioceptive Neuromuscular Facilitation (PNF) stretching to increase range of motion and muscle extensibility [25]. One of the four mechanisms by which PNF stretching increases motion is called Reciprocal Inhibition. It has been proposed that inhibition of the target muscle occurs when the opposing muscle is voluntarily contracted [25]. Contraction of an opposing muscle reduces neural activity through Ia afferent fibers resulting in subsequent relaxation of the target muscle [25].

The authors propose that muscular inhibition through Ia afferents can be applied in a more global manner by muscle contraction of the anatomically remote posterolateral hip cuff musculature (gluteus maximus and medius) to inhibit the target muscles of the posterior rotator cuff of the scapulohumeral joint (infraspinatus and teres minor). This novel inhibitory stretching technique is referred to as Inhibition Stretching (IS) and the specific technique utilized in this study is the Clam Shell Bridging Maneuver. This technique is recommended for overhead athletes with and without shoulder pain and limited GH IR.

***Stretchi*ng Procedure and Set-up – Clam Shell Bridging Maneuver**

In the hook-lying position with a resistive band around the distal femurs, the athlete is instructed to perform a hip-bridging maneuver by contracting the gluteal muscles (Figure 1). To further facilitate contraction of the gluteus medius, the subject performs a Clam Shell exercise by abducting the hips into the resistive band while the feet remain firmly planted on the ground [26]. The subject is instructed to perform and maintain an isometric gluteal set at the top of the bridge position.

Figure 1: Active-assisted internal rotation during the Clam Shell Bridging Maneuver

The upper extremity component of this active stretch is started with the shoulder in 90° of humerothoracic abduction since cadaveric studies suggest that this position provides the greatest stress to be applied to the posteroinferior glenohumeral capsule during passive [17, 27-28] as well as the inferior fibers of the infraspinatus muscle [29]. While maintaining the 90° of shoulder abduction and the clam shell bridge positions, the athlete is instructed to rotate their shoulder to end range actively internally and to then apply a gentle passive over-pressure to the distal forearm from the athlete's non-stretch hand for three sets of 30 second holds once daily (Figure 1). Athletes should be instructed to maintain the stretch intensity at the point of mild stretch discomfort. This maneuver is intended to isolate the structures of the posterior glenohumeral joint while providing stabilization to the scapula. It is proposed that inhibition of the posterior rotator cuff will facilitate greater muscle relaxation allowing more muscle elongation and less muscular guarding to allow for more focal posteroinferior glenohumeral capsule stretching.

In addition to the possible benefits of inhibiting the target muscles of the posterior rotator cuff, athlete positioning is designed to help stabilize the scapula without restricting the infraspinatus and teres muscle movement or compressing the posterior capsule. The bridging maneuver shifts the athlete's body weight, superiorly pinning the superior and medial borders of the scapula between the table and the thorax without directly compressing or restricting posterior shoulder structures. It is proposed that this position will allow greater freedom of motion with less discomfort.

Moore SD, et al. [30] using a single application of a muscle energy technique (MET) found an immediate improvement in shoulder horizontal adduction and IR in asymptomatic collegiate baseball players. Subjects were separated into 3 groups: 1) MET horizontal abductors, 2) MET external rotation, and 3) a control group. The MET horizontal abduction group had significant horizontal adduction and IR gains while both the MET external rotation group and control group did not realize any significant gains in ROM. It should be noted that the MET horizontal abduction group did not exceed the minimal detectable change (MDC) for IR ROM; however, they did exceed MDC for horizontal adduction ROM [30]. The authors [30] used a 5-second isometric contraction time and a 30-second duration post isometric active-assisted stretch as supported by osteopathic literature [31]. The subjects were instructed to contract at an approximate 25% of their maximum force [31]. This was the first study to investigate the use of MET to the upper extremity [31]. Our novel stretching technique is not a contract-relax (CR) stretching technique but it does share some of the muscle inhibition characterizes to MET. Unlike the previously discussed MET technique [31], our stretching procedure utilizes a different form of muscle inhibition - Reciprocal Inhibition. By contracting the internal shoulder rotators, first actively and then assistive-assisted while the athlete applies gentle pressure (active stretching), we hypothesize that inhibition of the scapulohumeral external rotators (e.g., teres minor, infraspinatus will occur [25]. It should be noted that Moore SD et al. study [31] was a manual technique provided by a trained healthcare provider. Our proposed technique is intended to be performed independently by the athlete as a part of a home or gym stretching program.

Historically, the contract-relax, PNF stretching techniques are more effective in increasing ROM as compared to static stretching [32-34]. All of these studies investigated the lower extremities and required assisted CR PNF or static stretching. As stated previously, our aim for our novel inhibitor stretch is that it be performed unassisted by the overhead athlete to give the athlete greater access to the intervention. A more recent study compared assisted and unassisted stretching for a variety of different PNF stretching techniques [e.g., hold relax, CR, and eccentric contractions (isolytic)] and static stretching techniques to the lower extremity [32]. The investigators found that all active and passive stretching groups, both assisted and unassisted, had significant and similar gains in ROM thus suggesting that individuals can implement PNF stretching with a clinician, with a partner, or independently [35]. This finding strengthens our proposed self-stretching protocol.

Recommendations for Future Research

The authors of this manuscript encourage researchers to perform a randomized clinical trial comparing this novel Inhibitor Stretching technique to either the mSS or mCBS in individuals with and without shoulder pain and movement limitations due to tightness of posterior shoulder structures.

Summary

Static stretching procedures (e.g., mSS, mCBS) that focus on posterior scapulohumeral muscles (e.g., teres minor, infraspinatus) and the posteroinferior capsuloligamentous complex are common and effective interventions to treat and prevent numerous shoulder conditions in overhead athletes. However, these stretches have caused pain in some athletes and are the primary reason that symptomatic subjects drop out of static stretching shoulder clinical trials. For these reasons, the authors have proposed a novel stretching procedure, the Clam Shell Bridging Maneuver, that is hypothesized to reduce the muscles guarding, and resistance of the shoulder girdle during stretching and also position the athlete in a way that helps minimizes pain and impingement during the stretch while still providing stabilization to the scapula.

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