EPHE 355- Assignment #2

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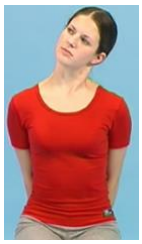
1. From the information given regarding Frank's condition, the pain experienced during an overhead tennis serve is likely due to improper scapula-humeral rhythm, and the humerus' inability to remain centered on the glenoid fossa.
   a. Frank's poor computer posture 40 hours/week has resulted in tightness of the levator scapulae, pectoralis minor and upper trapezius because of the prolonged scapular elevation and protraction. Levator scapulae and pectoralis minor act as downward rotators, so their tightness could be causing difficulty during upward rotation, and therefore impeding a smooth scapular-humeral rhythm when attempting the overhead serve. Upper trapezius, however, acts as an upward rotator, so its tightness would be limiting the ability for it to contract along with its agonist, lower trapezius, resulting in an ineffective upward rotation. These imbalances may lead to subacromial impingement, which is the source of Frank's pain. When he lifts his arm above his head to prepare for the tennis serve, the scapula doesn't upwardly rotate enough, causing the head of the humerus to contact the acromion process of the scapula and squish the contents between this articulation. This pattern of tight upper trapezius, and weak lower trapezius and serratus anterior is common among individuals with shoulder impingement (Struyf et al., 2014).
   b. The reason the head of Frank's humerus isn't centered in the glenoid is because of an imbalance of rotator cuff muscles. Because Frank spends so much time positioned in scapular protraction and medial rotation, his infraspinatus and teres minor are being weakened due to the constant lengthened position. This contributes to the head of the humerus sitting anteriorly to the normal anatomical positioning on the glenoid cavity. Teres minor and infraspinatus need to be strengthened to have a greater resting tone of the muscles to pull the head back posteriorly to center on the glenoid cavity. An anterior shift of the humerus could also be due to tightness of the posterior joint capsule (Ellenbecker & Cools, 2010).
   c. The tightness of Frank's downward rotators and un-centered humerus is preventing him from getting proper scapulo-humeral rhythm. With arm abduction during an overhead serve, the head of the humerus should be gliding inferiorly on the glenoid as it rolls superiorly. If the supraspinatus isn't active, the head of the humerus isn't sufficiently gliding, and it is not getting out from under the acromion. A such, the deltoid is pulling the head of the humerus into the acromion and all the structures that pass under the acromion are being compressed; this includes the subacromial bursa, the long head of biceps brachii, the tendons of rotator cuff muscles and the coracoacromial ligament (Pesquer et al., 2018). Nociceptors, which respond to painful stimuli and inflammation are activated at the side of the coracoacromial arch (Ide, Shirai, Ito, & Ito, 1996). Nociceptors are also located in the tendon of the biceps brachii, the tissue of the glenoid labrum, and the innermost layer of the joint capsule (Guanche, Noble, Solomonow, & Wink, 1999; Hashimoto, Hamada, Sasaguri, & Suzuki, 1994).

2. Stretching:

   We would get Frank to do a warm up before he begins stretching.
   After the stretching exercise, we would get Frank to work on active range of motion, and do a strengthening exercise for that muscle.
   Each exercise will be performed for a total of 60 seconds either in 2 sets of 30 seconds, or 4 sets of 15 seconds.

Frank's injury may have some associated inflammation; stretching should be avoided until the inflammation stage of tissue healing has subsided so as not to disrupt the development of granulation tissue. After the inflammation stage, stretching can be added to help align the random organization of the fibers.
We want Frank to stretch only until he feels resistance and not to the point of pain; this is to ensure that he is keeping his stretching within the elastic and plastic regions of the stress-strain curve, and not causing damage through failure to the bonds between the collagen fibrils.

Muscle:	Stretch:	Description:	Rationale:
Upper trapezius		Laterally flex neck toward opposing side, flex anteriorly and focus gaze toward ipsilateral side; lower ipsilateral shoulder and push down the contralateral hand to get a deeper stretch.	To lengthen the upper trapezius because it's tight
Lavator scapulae		Flex neck diagonally, anterior, and contralaterally, while rotating toward the contralateral side; then depress.	To lengthen the levator scapulae because it's tight
Pectoralis major		Start with the shoulder abducted, and externally rotated, horizontally extend and bend the elbow, stand with the hand resting on a wall, and rotate body away from that arm to deepen the stretch; to target different fibers, vary the level of abduction.	To lengthen the pectoralis major because it's tight
Pectoralis minor		Grasp hands behind back and pull them away from the body and superiorly while elevating and retracting the scapula; take a deep breath and lift up the chest to increase the stretch.	To lengthen the pectoralis minor because it's tight

Sternocleidomastoid		With a supported back, tuck the chin in and bring the one ear to the same shoulder. Look to the opposite side and tilt your head upwards.	To lengthen the sternocleidomastoid because it's tight
Suboccipitals		While seated, drop the chin toward the chest until you feel resistance. Breathe in and focus your eyes up towards your eyebrows. Exhale and relax your eyes to allow the head to lower further. Repeat the breathing and eye movements (Alexander, 2006).	To lengthen the suboccipitals because they're tight

Strengthening:

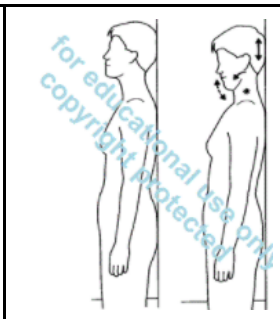
Frank would complete a warm up before his strengthening exercises (light recumbent biking for example).

Considering the low-intensity nature of the exercises, Frank should start with as many reps and sets as he can without showing signs of fatigue: uncoordinated movements; shaky, jerky, and unsmooth movements; substituted motions; decreased peak torque; and inability to reach full ROM. From this starting point, he should aim to progress to three sets of 10-15 reps performed twice a day for 5-7 days per week. Frank should rest two to three minutes between sets.

Muscle	Exercise	Description	Rationale
Serratus anterior grade 3		Starting from a standing position with shoulder in anatomical position elbow flexed to 90 degrees and fully protonated. Flex the shoulder till mid way while extending at the elbow.	To strengthen the serratus anterior because it is weak due to its constant lengthened position
Serratus anterior grade 4/5		Set up in a push up position, allow gravity to overtake the body by allowing the scapula to retract to the full ROM, allowing the scapulas come together, protract the shoulders to full ROM	To strengthen the serratus anterior because it is weak due to its constant lengthened position

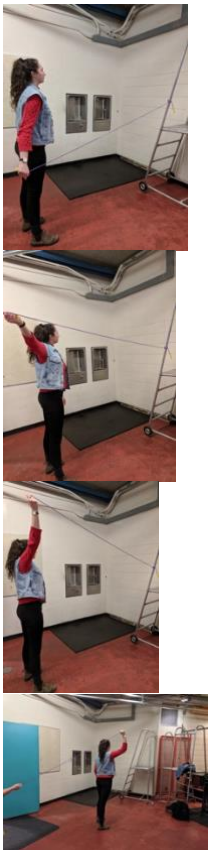
Lower trapezius grade 3		Stand against a wall, 90 degree flexion at elbow and abduction at shoulder. Extend at elbow, and abduct to 140 degrees, arms end position should look like a Y. Upward rotation is the desired movement of the scapula and should be focused on. Hands and arms must maintain contact with wall at all times.	To strengthen the lower fibers of the trapezius because it is weak due to its constant lengthened position
Lower trapezius grade 4		Lay face down on a comfortable but firm surface with arms positioned in a 'W' shape. Raise your arms up above your head into a 'Y' shape by upwardly rotating the scapula.	To strengthen the lower fibers of the trapezius because it is weak due to its constant lengthened position
Rhomboids grade 3		Bend torso forward at the waist and retract the scapula while bending the elbow and pulling the arm upwards.	To strengthen the rhomboids because it is weak due to its constant lengthened position
Rhomboids grade 4		Perform the same exercise described for grade 3, but hold a resistant band in the working hand to increase the difficulty.	To strengthen the rhomboids because it is weak due to its constant lengthened position
Infraspinatus & Teres Minor grade 3/ 3+		Lay on one side with the lower arm supporting the head. Start with the upper arm flexed to 90 degrees at the side of the body, and externally rotate at the shoulder. The exercise can be progressed by adding a weight to the hand.	To strengthen the muscles that pull the humerus posteriorly in order to centre the humeral head on the glenoid throughout the full ROM.

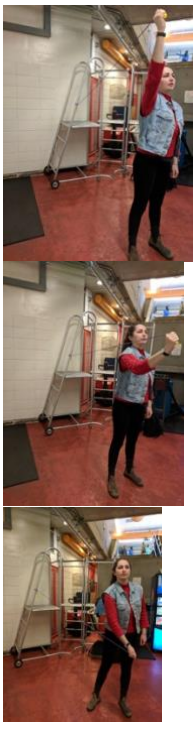
Infraspinatus & Teres Minor grade 4		Prepare by standing with the elbow flexed to 90 degrees at the side of the body. Attach tubing to a secure location on the opposite side of the body, and hold the other end in the hand. Externally rotate at the shoulder against the resistance of the tubing. Progress by using stronger tubing.	To strengthen the muscles that pull the humerus posteriorly in order to centre the humeral head on the glenoid throughout the full ROM.
Infraspinatus & Teres Minor grade 4 Progressed	 	Prepare by standing straight and abducting the arm to 90 degrees to put the tubing under tension with the elbow flexed to 90 degrees. Externally rotate at the shoulder in the sagittal plane.	To strengthen the muscles that pull the humerus posteriorly in order to centre the humeral head on the glenoid throughout the full ROM.
Functional Rotator Cuff		Hold tubing in one hand and abduct the arm to just above 90 degrees with a slight bend in the elbow. Make overhead figure-8 movements with the hand.	To stabilize the position of the head of the humerus in the glenoid fossa.
Advanced Strengthening of Shoulder		Lie on one side with the weight distributed between the feet on a roller and the forearm on the ground. Keep the core engaged as the shoulder adducts and abducts. Make sure not to abduct more than 90 degrees.	To strengthen multiple muscles at a time in a more functional approach.

Deep cervical flexors grade 3		Stand against a wall, ensuring the scapulae and back of the head are against the wall. Lift the chin slightly. Slowly move the back of the head up the wall so that the chin points down. Move as far back as possible while the head stays against the wall and then return to the starting position.	To strengthen the deep cervical flexors and provide more stability.

Function movements (grade 5):

Once Frank has addressed the specific muscle imbalances and has worked to strengthen and stretch them individually, he can start to integrate these muscles in a more functional way. The following exercises will ensure Frank can perform the overhead serve motion with proper scapulo-humeral rhythm and will help to fine tune the muscular activations.

Muscle	Exercise	Description	Rationale
Rhomboids, lower trapezius, teres minor, infraspinatus		Start standing with arms at the sides. Hold one end of the band and attach the other end to a fixed structure in front. Slowly bring one arm backwards in an upward arc (like the upswing of a serve) until it is perpendicular to the ground. To progress, speed up the movement or use a higher tension band. Another option is to have someone pulling on the other end of the resistance band to help maintain tension and adjust the difficulty of the exercise.	This exercise incorporates strengthening exercises for weak scapula retractors, shoulder abductors and lateral rotator cuff muscles. It also resembles the action of a tennis serve and can be sped up to match game speed.

Serratus anterior		Hold a resistance band with one hand and tie the other end to a fixed structure above. Bring the arm forwards in a downward arc across the body (like the downswing of a serve). To progress, speed up the movement or use a higher tension band. Someone can also pull on the other end of the band to add extra resistance and maintain tension.	This exercise strengthens the shoulder abductors and scapular protractors. It resembles the downswing in a tennis serve and can be sped up to match real game speeds. These two exercises also work on proper scapulo-humeral rhythm

3. While he's at work, we would recommend Frank adjust his posture to ensure proper muscle activation. This means consciously sitting up straight to reduce the curvature of the cervical and thoracic spine, and engaging the muscles performing shoulder retraction. Additionally, Frank needs to reduce activation of the upper fibers of the trapezius and the levator scapulae by trying to keep his scapula depressed, in a neutral position, throughout the day. These postural changes might require modifications to his desk such as raising his monitor to eye level, raising his chair so his forearms are resting evenly on the desk, and getting a desk chair that provides back support.
At home we would want Frank to continue his stretching and strengthening exercises on a daily/weekly basis to maintain the new ROM and strength. While in the car between work, home and other activities, we would encourage Frank to practice the upright posture described previously, as well as doing the stretching exercises for upper trapezius and levator scapulae when safely stopped at a red light (for example). When back at tennis without experiencing shoulder impingement, in order to prevent symptoms from coming back, Frank should ensure he gets an adequate upper body warmup before starting the game (and especially prior to his first overhead serve). This warmup is not limited to but could include: rolling shoulders backward, rolling shoulders forward, bringing one arm across the body and holding, bringing the other arm across the body and holding, wrist circles, and full arm circles forward and backward. Overall, we would encourage Frank to keep up his physical activity, but not to continue through any pain or discomfort.

References

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