The use of kinesio tape, with a strengthening protocol, in aiding scapular retraction through facilitation of the rhomboids

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The use of kinesio tape, with a strengthening protocol, in aiding scapular retraction through facilitation of the rhomboids

**CONTEXT:** Rounded shoulder posture (RSP) is a type of poor upper body posture that can lead to other biomechanical changes of the body, as well as pathological issues. Kinesio tape (KT) facilitation, along with a strengthening protocol, on the rhomboid muscles will aid in scapular retraction. **OBJECTIVE:** To examine effects of KT facilitation of the rhomboid muscles on static and dynamic postural changes when KT facilitation is combined with a strengthening protocol focused on the rhomboid muscles. **DESIGN:** Repeated measures, randomized experimental study. **SETTING:** Division III liberal arts college. **PARTICIPANTS:** 11 participants with RSP (6 male, 5 female, age 28.8 ± 13.0 years). **INTERVENTION:** Pre-Test performed that included three exercises, three sets of ten reps each, followed by the application of KT on the rhomboid muscles. Repeat of the three exercises followed. Strength protocol performed four times over next two weeks, with the fourth time becoming the post-test. Static videos of participant’s RSP taken throughout the pre and post-test and analyzed for results. **OUTCOME MEASURES:** Dartfish Motion Analysis Software (Dartfish Inc., Fribourg, Switzerland) used to analyze differences in RSP over the course of the pre-test to the post-test. Used mixed-model ANOVA with a repeated-measures factor in SPSS. **RESULTS:** Comparisons of experimental and control groups, effect of intervention over time, and interaction effects were not significant ($p < .05$). **CONCLUSION:** KT, with a strengthening protocol for the rhomboids, may not be an effective solution for RSP. Further testing needs to occur with greater number of participants.

**Keywords:** kinesio tape, rounded shoulders, strengthening
INTRODUCTION

In the past thirty years, computer use has drastically increased in offices\(^1\) as well as in other settings, such as schools. This situation has led to a drastic increase in prolonged sitting, which exposes persons to poor postures, such as rounded shoulder posture (RSP).\(^1\) RSP is a joint position that can be created out of habit.\(^1\) According to Han,\(^2\) trunk flexion, which affects the pectoral muscles by shortening them, and forward head posture can, overtime, cause the shoulders to protract. RSP will also lead to an elongation of some of the muscles affecting the scapula, including the rhomboid muscles, which aid in retracting the scapulas.\(^3\) If this positioning is not fixed, it can lead to pathologies such as change in the kyphotic and lordotic curves of the spine, scapular winging, and thoracic outlet syndrome.\(^2\) These different pathologies can ultimately lead to pain in the upper extremity as well as loss of function in the shoulder.\(^2\)

Kinesio Tape (KT) was developed in the 1970s by Dr. Kenzo Kase.\(^4\) It was made to replicate the elasticity of skeletal muscle when applied, and is able to stretch up to 140% of its original length.\(^2\) Some KT claims include that it is useful for correcting a muscle’s function; improving joint position; improving lymphatic and blood circulation; decreasing pain;\(^5,6\) and repositioning a subluxated joint.\(^7\) There have been several studies\(^8,9,10\) that had positive results with the use of KT on the lower extremity.

Unlike the lower extremity, the upper extremity has less research regarding the use of KT. A previous study\(^2\) investigated mechanical correction of RSP using regular tape; however, research investigating the effectiveness of KT in correcting RSP is lacking.\(^2\) Two ideas\(^2,4,11\) that have been studied previously are immediate correction of rounded shoulders and increasing muscle strength with KT. Through these studies,\(^2,4,11\) only inconclusive results have been
attained. Furthermore, a muscle that has yet to be studied for the correction of RSP is the rhomboids.

The purpose of this study is to examine the effects on dynamic postural control when combining KT facilitation and strengthening for the rhomboid muscles. It is hypothesized that, in persons with RSP, KT facilitation of the rhomboid muscles combined with a strength protocol will produce greater changes in scapular retraction than KT facilitation of the rhomboids alone.

LITERATURE REVIEW

Anatomy

Bony Structures and Their Ligaments

The clavicle attaches to the manubrium, the superior section of the sternum, at the clavicular notch. This attachment is labeled the sternoclavicular joint and makes up the only attachment of the shoulder to the axial skeleton. At this joint, the clavicle is stabilized by several ligaments. The anterior sternoclavicular ligament resists posterior displacement while the posterior sternoclavicular ligament resists anterior displacement. The interclavicular ligament lies on the superior border of the sternum and connects the two sternoclavicular joints. It resists downward force of the clavicle and distributes forces across the upper extremity. Lastly, the costoclavicular ligament, connects from the superior border of the first rib to the inferior border of the clavicle. It limits elevation and medial movement of the clavicle.

The scapula connects to the clavicle at the acromioclavicular joint. This is the connection of the distal clavicle and the acromion of the scapula. The acromion is a bony projection on the axillary (lateral) side of the scapula that reaches anteriorly to meet the clavicle. The acromioclavicular ligament and the coracoclavicular ligament stabilize this joint. The coracoclavicular ligament is separated into two sections, which, together, limit scapular rotation. One section is the trapezoid ligament; it restricts lateral translation of the clavicle over the
acromion. The second section is the conoid ligament; which restricts superior movement of the clavicle. Another bony process of the scapula is the coracoid process which extends anteriorly and inferiorly. The scapula’s anterior surface forms the subscapular fossa. The posterior surface is made up of the supraspinous fossa and infraspinous fossa, which are divided by the scapular spine. There are two borders of the scapula, the medial (vertebral) border and the lateral (axial) border. The medial border is between the superior and inferior angles.

The humerus, specifically the humeral head fits into the glenoid fossa on the lateral side of the scapula. The humerus itself has several attachment points for muscles. The bicipital groove is on the anterior side of the humerus in the upper quarter section. On the lateral side of the bicipital groove is the greater tuberosity, and on the medial side is the lesser tuberosity. The deltid tuberosity is located on the lateral side of the humerus and is slightly above the midshaft. This, along with the ligaments and muscles surrounding it, makes up the glenohumeral joint. Ligaments that support this joint are the glenohumeral ligaments and the coracohumeral ligaments which are both located on the anterior side of the glenohumeral joint. These two sets of ligaments aid in restricting several different motions of the joint when the humerus is placed in different positions. Another ligament of the joint, that specifically aids in protecting the superior area of the humeral head is the coracoacromial ligament, connecting from the acromion to the coracoid process.

One last joint, that is not an actual true joint anatomically, is called the scapulothoracic articulation. This is the articulation of the posterior rib cage and the scapula and this “joint” moves when the acromioclavicular and sternoclavicular joints move.

*Muscles and Their Actions*
There are several muscles that act on the scapula. The pectoralis minor attaches to the coracoid process of the scapula and aids in anteriorly tilting the scapula. The trapezius muscles consist of the upper, middle, and lower sections. The upper trapezius elevates and superiorly rotates the scapula. The middle trapezius retracts the scapula and the lower trapezius depresses and superiorly rotates the scapula as well as externally rotates and posteriorly tips the scapula. The upper and middle trapezius attach to the acromion process and the spine of the scapula while the lower trapezius attaches to the spine of the scapula. The upper trapezius is the most powerful muscle between all three trapezius muscles. It’s hyperactivity often leads to hypoactivity or weakness of other muscles around it. The serratus anterior attaches to the superior angle and medial border of the scapula; it superiorly rotates and protracts the scapula as well as aids in fastening the scapula to the thorax. The levator scapulae attaches to the superior angle of the scapulae and elevates as well as inferiorly rotates it. The rhomboid minor sits on top of the major and originates at the seventh cervical vertebrae to the first thoracic vertebrae, while inserting on the medial border of the scapula. The rhomboid major’s fibers begin at the second thoracic vertebrae to the fifth thoracic vertebrae, and insert on the vertebral border of the scapula. When working together, the rhomboid muscles, levator scapulae, and the serratus anterior retract the scapula towards the spine, as well as help inferiorly rotate and elevate the scapula.

Focusing on the muscles of the glenohumeral joint, there are four that originate off the scapula and make up the rotator cuff, which helps move the humerus into different planes of motion. The subscapularis muscle is located on the subscapular fossa, attaches to the lesser tuberosity and glenohumeral joint capsule and internally rotates the humerus. The supraspinatus muscle, located in the supraspinous fossa, attaches to the greater tuberosity and glenohumeral
joint capsule, and it externally rotates and abducts the humerus.\textsuperscript{3} The infraspinatus muscle, located in the infraspinous fossa, is attached to the greater tuberosity and glenohumeral joint capsule.\textsuperscript{3} It externally rotates the humerus.\textsuperscript{3} Lastly, the teres minor muscle originates at the axillary border of the scapula and inserts on the inferior aspect of the greater tubercle.\textsuperscript{3} It externally rotates and horizontally abducts the humerus.\textsuperscript{3} These four muscles all aid in limiting extra movement of the humeral head in the glenoid fossa and compress the head into the joint for stabilization.\textsuperscript{3}

Other muscles that aid in moving the humerus include the teres major, deltoid muscles, the pectoralis major, the latissimus dorsi, biceps brachii, triceps brachii, and the coracobrachialis.\textsuperscript{3} The teres major originates on the scapula and attaches to the bicipital groove.\textsuperscript{3} Its action is to extend, internally rotate and adduct the humerus.\textsuperscript{3} The deltoid muscle group has three sections, the anterior, middle and posterior fibers.\textsuperscript{3} The anterior section originates at the anterior section of the lateral clavicle.\textsuperscript{3} The middle section originates at the acromion process and spine of the scapula.\textsuperscript{3} The posterior section originates at the spine of the scapula as well.\textsuperscript{3} All fibers attach to the deltoid tuberosity.\textsuperscript{3} The anterior and middle fibers perform flexion and abduction of the humerus while the anterior section also internally rotates and horizontally adds the arm.\textsuperscript{3} The posterior fibers externally rotate, extend, abduct and horizontally abduct the humerus.\textsuperscript{3} The pectoralis major, while it acts on the scapula, also performs adduction, horizontal adduction and internal rotation of the humerus.\textsuperscript{3} Being more specific, the clavicular section of the pectoralis major aids in flexion of the arm.\textsuperscript{3} The latissimus dorsi muscle is a broad muscle that attaches at the bicipital groove of the humerus.\textsuperscript{3} It adducts, extends and internally rotates the arm.\textsuperscript{3} Another muscle that adducts and extends the arm is the triceps brachii, specifically the long head of the triceps.\textsuperscript{3} On the other hand, the biceps brachii produces flexion
and abduction. These muscles originate on the scapula and attach at the radius of the forearm.

Lastly, the coracobrachialis muscle flexes and adducts the arm as it originates on the coracoid process and attaches to the medial shaft of the humerus.

**Biomechanics/Pathomechanics**

The combined movements of the scapulothoracic articulation and the glenohumeral joint is called scapulohumeral rhythm. This rhythm is defined by a ratio of movement from each joint/articulation. For instance, if the humerus were to be raised to 180 degrees, about 120 degrees of movement is coming from the glenohumeral joint while the other 60 is coming from the rotation of the scapula. Therefore, without the movement of the scapula, the humerus could only be raised 120 degrees. This difference in degrees of movement coming from the glenohumeral joint and the scapula is formed into a 2:1 ratio, 2 encompassing the 120 degrees of glenohumeral movement and 1 encompassing the 60 degrees of scapula movement. This ratio can vary slightly, depending on the individual and their mobility. The ratio also varies throughout the entire humeral motion itself. About the first 30 degrees of humeral elevation is from the glenohumeral motion while the scapula simply provides stability. Following the first 30 degrees, the scapula becomes more involved in providing more motion for the humerus. Finally, when the humerus reaches full elevation, the glenohumeral joint takes over again to reach 180 degrees, while the scapula provides only stability. This rhythm can be abnormal if the muscles acting on the humerus and scapula are injured, weak, or imbalanced. An abnormal rhythm of the scapula can be seen by assessing posture. At a resting position, the scapula should have an anterior tilt of 15 degrees, internal rotation of 40 degrees and upward rotation of 5 degrees. If the positioning of the scapula is abnormal, there may be excessive or insufficient internal rotation, anterior tilt and/or upward rotation. If there is abnormal positioning, the scapula will typically sit protracted, lower, and with an excessive anterior tilt, as if the shoulders
were “rounding” forward. Protraction is when the scapula is moved or sits further away from the spine. This can be done actively, as in giving yourself a hug, or it can be passive, due to weak muscles. If the protraction occurs passively, it is considered rounded shoulder posture.

Focusing on postural conditions, RSP is a joint position that can be created out of habit. According to Han, trunk flexion, which affects the pectoral muscles by shortening them, and forward head posture can cause the shoulders to protract over time. RSP can also lead to an elongation of some of the back muscles, including the rhomboid muscles, which aid in retracting the scapulas. These muscle imbalances could, over time, lead to problems such as excessive kyphotic and lordotic curves of the spine, scapular winging, and thoracic outlet syndrome, yet these dysfunctions may not always be correlated with RSP.

The spine already has a natural kyphotic curve, which is an convex curve of the thoracic spine, and a natural lordotic curve, which is the concave curve of the spine in the cervical and lumbar regions. However, excessive curvature is often due to tissue changes. Increased kyphotic curve may be caused by tight anterior muscles, such as the pectoralis muscles, and weak, elongated posterior (back) muscles. Having an excessive kyphotic curve can also lead to an increased lordotic curve of the cervical spine. This can be due to the head having to stay upright to keep the eyes level which can result in forward head posture. An increase in lordotic curve of the lumbar spine is often seen with kyphosis as well. Excessive kyphotic and lordotic postures can increase in order to compensate for equilibrium of the spine, and constant compensation can lead to pain, due to poor posture mechanics.

Another anatomical issue from muscle imbalance is scapular winging. In general, scapular winging is caused from weakness of scapular muscles such as the serratus anterior, middle and lower trapezius muscles, rhomboid minor and rhomboid major. When a muscle is at
rest, but elongated past the normal length, then that indicates muscle weakness. Muscle weakness can lead to the inability for the muscle to hold a joint in proper alignment. Improper alignment is how scapular winging can be recognized, which is by the appearance of the medial border and/or inferior angle of the scapula when at rest and throughout humeral movement. There are several ways to note scapular winging on a subject. These include having the subject follow through scaption range of motion while holding weights, measuring the distance from the spine to different points of the scapula bilaterally, and having the subject perform a wall push-up. If the patient has pain, ROM limitations and/or muscle weakness and imbalance, then focusing on restoring normal scapular movement will be necessary.

A more severe pathology that could occur from RSP is thoracic outlet syndrome (TOS). Severe RSP can depress the clavicle and lead to an increased pressure on a neurovascular bundle that runs between the clavicle and the first thoracic rib. Ultimately, this leads to neurological issues, such as numbness and tingling, and pain in the upper chest and arm of the involved side. If RSP is the cause of the occurring thoracic outlet syndrome, then fixing the poor posture can decrease the symptoms.

**Previous Research**

*Interventions for RSP without KT*

Two studies investigated interventions for poor posture. These interventions include bracing, stretching, massage and posture shirts. One study, performed by Rather et al, studied the difference in muscle power, specifically isometric shoulder elevation strength, between subjects who either had normal posture or chronically protracted shoulders. There were 23 participants divided into groups by posture type, protracted shoulder posture group and normal posture group. Inclusion criteria included reaching range of motions of at least 180 degrees of glenohumeral elevation, 90 degrees of glenohumeral external rotation, and 70 degrees
of glenohumeral internal rotation.\textsuperscript{12} The participant also needed to be pain free during range of motion. Rather et al\textsuperscript{12} tested the subjects in three different positions. Each participant was seated in a ridged chair with their trunk strapped to it to hinder excess movement of the body.\textsuperscript{12} The participant rotated through scapular positions of neutral, protraction and retraction and held an isometric contraction for each.\textsuperscript{12} An isometric contraction is a contraction that does not change a muscle’s length.\textsuperscript{3} Each contraction, for each position, was held 3-5 seconds.\textsuperscript{12} A testing apparatus was used to measure the strength of each hold.\textsuperscript{12} The results concluded that, overall, the normal posture group had higher strength levels during their contractions and that isometric shoulder elevation strength is affected by the position of the scapula.\textsuperscript{12}

The study done by Rather et al\textsuperscript{12} supports that strength levels, can indeed be impaired with RSP. One protocol aimed at correcting RSP was studied by Cole et al,\textsuperscript{13} and they focused on bracing with strengthening. The study’s purpose was to investigate how a scapular brace affected shoulder range of motion and rehabilitation performance.\textsuperscript{13} The study\textsuperscript{13} focused on overhead athletes that had forward head, rounded shoulder posture. There were 38 participants recruited that met the criteria of having forward head, rounded shoulder posture.\textsuperscript{13} Random assignment, of experimental or control groups, was given to the participants.\textsuperscript{13} The control wore a compression shirt with no tension in the straps (no bracing), and the experimental group wore the compression shirt that had tension in the straps.\textsuperscript{13} Posture was measured before and after the shirt was worn.\textsuperscript{13} Each participant underwent rehabilitation with 4 exercises: scapular punches, “W’s,” “Y’s,” and “T’s,” as well as flexion and extension of the shoulder for range of motion.\textsuperscript{13} Electromyography (EMG) was measured of the trapezius muscles and the serratus anterior.\textsuperscript{13} The results concluded that wearing the brace with the tension in the straps decreased forward shoulder angle.\textsuperscript{13}
However, the EMG results were not definitive enough to conclude that scapular bracing aids in improving muscle activity for poor posture in overhead athletes.\textsuperscript{13}

Wong et al\textsuperscript{14} investigated the effects of manual soft tissue mobilization (STM) and self-stretch on the pectoralis minor muscle while analyzing lower trapezius strength. There were 28 participants included based on having a distance of 2.5 cm or greater between their posterior acromion and the table while they were laying down.\textsuperscript{14} Exclusion criteria were shoulder pain, history of cardiac and neurological symptoms, shoulder surgery, or prescriptions that affect muscle activity.\textsuperscript{14} The participants were randomly assigned to a treatment protocol.\textsuperscript{14} The experimental treatment consisted self-stretch of the pectoralis minor muscle and soft tissue mobilization, while the placebo treatment was light, passive placebo touching and self-stretching of the pectoralis minor muscle.\textsuperscript{14} The participants were re-measured to note any differences between baseline and post-intervention.\textsuperscript{14} The treatment group decreased their measurements of RSP significantly after their session.\textsuperscript{14} Lower trapezius strength increased for both the treatment and placebo group.\textsuperscript{14} This concluded that both soft tissue mobilization combined with self-stretch can reduce RSP.\textsuperscript{14}

**Kinesio Tape (KT)**

*History/Claims KT*

In the 1970s, KT was developed by Dr. Kenzo Kase.\textsuperscript{4} It was made to replicate the elasticity of skeletal muscle when applied to the skin, and is able to stretch up to 140\% of its original length.\textsuperscript{2} The tape is manufactured with a weave-like design on the adhesive side.\textsuperscript{8} The weave allows ventilation, more elasticity, little skin discomfort and water-resistance; which enhances the tape’s function and allows it to be used in multiple ways.\textsuperscript{8} KT has been used to treat sports-related conditions, including neuromuscular and orthopedic injuries.\textsuperscript{2} Some KT claims
include correcting a muscle’s function, improving joint position, improving lymphatic and blood circulation,\textsuperscript{2} decreasing pain,\textsuperscript{5,6} and repositioning a subluxated joint.\textsuperscript{7}

**Muscle Facilitation using KT**

There have been several studies\textsuperscript{8,9,10} that had positive results with the use of KT on the lower extremity. Huang et al\textsuperscript{8} looked at the effect of KT on vertical jump performance. The study’s purpose was to test whether muscle activity in the triceps-surae muscles, would increase when KT was applied.\textsuperscript{8} Jump height was also analyzed to note if it increased with an increase in muscle activity.\textsuperscript{8} The triceps-surae muscles are the two gastrocnemius heads and the soleus muscle.\textsuperscript{3} Thirty-one healthy individuals were included if they were physically inactive.\textsuperscript{8} Exclusion criteria included history of knee, spine, foot and hip pathologies and lower-limb fractures as well as neurological impairments.\textsuperscript{8} All of the participants completed a five-minute warm-up on a treadmill and then a two-minute instruction period on how to correctly perform a vertical jump.\textsuperscript{8} Afterwards, each participant completed the vertical jump tests, five at maximal effort, as a baseline measurement and were randomly assigned elastic or non-elastic tape to be applied.\textsuperscript{8} The tape was applied to the triceps-surae in a “Y” style, and the participant completed the vertical jump tests again.\textsuperscript{8} The study\textsuperscript{8} concluded that there was no statistical difference on jump height. However, Huang et al\textsuperscript{8} reported significant increase of muscle activity of the medial head of the gastrocnemius immediately following the application of the elastic tape (KT).\textsuperscript{8}

Another study,\textsuperscript{9} that also analyzed KT and vertical jumping, looked at dynamic postural control as well, which was tested with the Star Excursion Balance Test.\textsuperscript{9} This study, performed by Nakajima et al,\textsuperscript{9} included 52 subjects that received KT or a placebo taping. The purpose of the testing was to evaluate whether KT affected dynamic postural control and the vertical jump.\textsuperscript{9}
The subjects were young and healthy and did not have a history of lower extremity injuries. Baseline examination was performed on each participant to rule out ankle instability, and baseline measurements were taken of the vertical jump and dynamic posture control test. Afterwards, assignment to the experimental KT or the sham KT was given to each participant. Each participant had several “Y” strips placed from the foot/ankle to bony prominences below the joint line of the knee. The experimental tape was stretched while the sham taping was applied without stretch. After taping, vertical jump tests and dynamic postural control tests, using the Star Excursion Balance Test for dynamic posture control, were performed. Instructions were given, to wear the tape for 24 hours and to return to the testing area to be re-evaluated. The end results concluded that there was no statistical difference in vertical jump height after the application of the experimental KT. There was, however, a significant improvement on the Star Excursion Balance Test scores of the female participants after KT was worn for 24 hours.

While Huang et al and Nakajima et al focused on simply increasing muscle facilitation through the application of KT, Alvarez et al studied the use of KT in preventing muscle fatigue in the low back region. To prevent muscle fatigue, there must also be an increase in muscle facilitation, which was studied by the application of KT. The study used 99 healthy young subjects who were randomly assigned to be in the KT, placebo tape, or control groups and the Biering-Sorenson test was used to test muscle fatigue. The purpose of the study was to determine if KT influenced the resistance to fatigue in the lumbar extensor muscles. Exclusion criteria were neurological and cardiovascular diseases, and pain from a tumor, infection or injury to the area being tested. Those that were in the control group had no tape applied and those that were in the placebo taping group had two strips of tape applied without a stretch, transversely across the lumbar region. The experimental taping group had two strips of KT applied
vertically with a stretch on the lumbar region. The Biering-Sorenson test was used to assess endurance of the trunk extensor muscles for all groups. The participant held a stable position of the back (trunk) while lying face down on a table, with the upper body suspended off of the table, unsupported. The lower body was strapped to the table. The participant held the position while being timed. When the participant’s trunk dropped below horizontal level of the rest of the body, the timer was stopped. The control group had the poorest performance in times while the experimental group had the highest times. Results concluded that KT improved the time to failure, with the Biering-Sorenson test. This finding concluded that KT could be used in managing low back pain.

Zanca et al also performed a study on muscle facilitation with KT in preventing muscle fatigue. The purpose was to test how lower trapezius facilitation was affected by KT, when analyzing scapular movement. This followed a fatigue protocol, of healthy overhead athletes. Zanca et al hypothesized that, greater facilitation of the lower trapezius would lead to greater assistance to the serratus anterior muscle during the throwing motion. The increase in facilitation would minimize alterations of the scapula during muscle fatigue. Twenty-eight overhead athletes that participated in sports training three or more times a week were included. Participants were excluded if they had any shoulder injury symptoms. To start the study, the skin of the participants was prepped, and electrodes were placed around the upper and lower trapezius muscles and the serratus anterior. Activation of each muscle was recorded while the participant was at rest, during a five second isometric contraction of each muscle after the resting period, and during arm elevation and depression following the isometric contractions. This testing was done in order to see baseline measurements of “normal” activation for each muscle in different positions. After initial measurements were taken, KT was applied to each
Each participant was randomly selected to have either the experimental taping or the sham taping applied. For the experimental taping, a “Y” shape strip was applied from origin to insertion of the lower trapezius, but placed on a stretch of 25%, while the sham taping was not placed on a stretch. After the taping procedure, each participant then performed a fatigue protocol of overhead throwing. The fatigue protocol consisted of each participant sitting in a chair and throwing a rubber ball at a wall that was two and a half meters away. The goal was to throw the ball hard enough that it returned to their hands, and to continue throwing the ball until their fatigue reached a level of eight or greater on the Borg’s Rate of Perceived Exertion Scale. Borg’s scale is used to rate, subjectively, a participants level of muscle fatigue and compare it to actual muscle fatigue levels on an EMG. After the participant reached a level of eight on Borg’s scale, they then re-measured muscle activation of the three muscles using the same procedure as baseline. The overall results showed no relevant effects of the KT on scapular movements and no difference in fatigue protocol duration between the sham and experimental tapings. However, there was a decrease in EMG frequency of the serratus anterior from pre-to-post measurements in the experimental taping which indicates lower muscle fatigue.

*Kinesio Tape and RSP*

An idea that has been studied previously are immediate correction of rounded shoulders with KT. Although KT has been used previously to correct RSP, there are inconsistent results regarding its long-term benefit on the condition.

One study, performed by Han et al, measured the effects of KT on RSP by detecting any change in pectoralis minor length, total scapular distance and the supine measurement of RSP, before and after application. These changes were assessed after rounded-shoulder-taping. Rounded shoulder taping included stretch for experimental taping, and no stretch for the placebo effect. Exclusion criteria of the study included: neck or shoulder surgery, shoulder or neck pain,
and neurological and cardiac pathologies.\textsuperscript{2} Several measurements were taken before taping began.\textsuperscript{2} The first was the RSP measurement which was taken with the patient lying down on a table.\textsuperscript{2} The posterior acromion was marked and a ruler measured the distance of the mark to the table.\textsuperscript{2} If the distance was greater than one inch, then the subject was included in the study.\textsuperscript{2} The next measurement taken was the pectoralis minor length in which the distance from the inferior aspect of the coracoid process to the sternocostal joint of the fourth rib was measured and recorded.\textsuperscript{2} The last measurement was the total scapular distance which was measured from the third thoracic spinous process to the inferior angle of the acromion.\textsuperscript{2} After baseline measurements were taken, tape was assigned randomly for each participant with or without a stretch, from the acromion’s anterior aspect to the tenth thoracic vertebrae.\textsuperscript{2} The first two strips of the experimental taping were placed on a stretch of 30-40\% and the third piece placed without a stretch.\textsuperscript{2} Each piece overlapped the next by 50\%.\textsuperscript{2} If the participant had the placebo taping, the first two pieces were placed without a stretch and the third piece was placed with a stretch.\textsuperscript{2} All three measurements were taken again and results were computed.\textsuperscript{2} Han et al\textsuperscript{2} found an immediate decrease in RSP and total scapular distance with an increase in pectoralis minor length, with the experimental KT that was stretched 30-40\% and placed from the acromion’s anterior aspect to the spinous process of the tenth thoracic vertebrae.\textsuperscript{2} Han et al\textsuperscript{2} concluded that KT with stretch corrected RSP.

\textit{KT with Strength Protocols}

While there is some research on KT correction of RSP,\textsuperscript{2} there is also research on combining KT and a strength protocol. Meyer\textsuperscript{4} studied the effects of KT and placebo taping on facilitation of the upper trapezius, while including a strength protocol before and after tape application. There was random assignment of two groups.\textsuperscript{4} The first group had KT applied to
them for one week and group two received leukotape (placebo) for the same week. Both tapes were tan in color for further blinding. Strips were placed on the dominant arm of each participant. Each participant was given a week off before repeating the taping protocol with the other tape. Strength testing was completed before and after taping using an isometric dynamometer. Three-second isometric shoulder shrugs were performed on the dominant arm, separated by 30 seconds rest. Isometric tests were performed three times. Each participant wore the tape for three days and after three days, each participant again performed three trials of the isometric shoulder shrug. The tape was then removed and more shoulder shrugs were completed. The study revealed no difference in KT and placebo tape for facilitating the upper trapezius, but both groups improved in the strength trials. Meyer suggested that there could have been some positive impact from the KT application to the strength testing.

Another study that focused on strengthening was performed by McGarvey et al, who focused on other conditions besides RSP. McGarvey et al performed this study to investigate which strengthening exercises incurred the most dynamic activity in the trapezius muscles and other scapular muscles. Inclusion criteria was neck dissection surgery for cancer in the past 2 years with pain in the involved shoulder and each patient had accessory nerve dysfunction. Ten electrodes were placed over 4 muscles and 2 bony areas on each participant. The four muscles were the upper and middle trapezius, serratus anterior and the rhomboid muscles. The 2 bony prominences were the spinous process of the seventh cervical vertebra and the clavicle, on the same side that was being tested. The participant was instructed to perform a series of 7 exercises with a weight of 2 kg. There were 30 seconds rests between repetitions and 60 second rests between exercises. Each repetition was held for 3 seconds and returned to a relaxed position in 3 seconds. Data was collected through EMG activations. The serratus anterior,
trapezius muscles and the rhomboids all had certain levels of activation with certain exercises. For the rhomboids, specifically, both the row, standing and laying prone (on the stomach), showed the highest EMG activity. These two exercises were chosen to be included in this study for the strength protocol.

**RSP and Rhomboid Muscles**

Altogether, studies focusing on correcting RSP without KT or strengthening have had positive results. The studies above focused on the upper extremity and the lower extremity while investigating facilitation of muscles, correction of RSP, and the use of KT with strengthening. Through the studies of RSP and KT, along with KT and strengthening, inconclusive results have been attained. A muscle that has yet to be studied for the correction of RSP is the rhomboid muscles, more specifically the rhomboid major and rhomboid minor. With previous supportive research completed on muscle facilitation and KT, hypothetically, there should be some increase in muscle activation or postural correction if KT is placed on the rhomboid muscles. Furthermore, strengthening of any muscle will produce a stronger and bigger muscle and could aid in postural correction.

**METHODS**

This study executed a randomized control experimental design. A repeated-measures factor was incorporated with the addition of the strength protocol. The study was approved by the Marietta College Human Subjects Committee.

**Participants**

Eleven participants (6 male, 5 female, age $28.8 \pm 13.0$ years) were recruited from the Marietta College campus, after having met the inclusion standard. Participants were included if they were 18 years or older and had RSP, which presented as the acromion process laying anterior to the ear lobe during static posture assessment. Participants were excluded from the
study if they had history of an upper extremity injury of a fracture or a dislocation in the past 6 months, a history of neck or shoulder surgery, neurological or cardiac pathologies or any allergic reaction to the KT. Participants who had any spinal deformities such as Sprengel’s deformity, scoliosis, kyphosis, spondylolysis, spondylothesis, and any other injuries pertaining to the spine that would prevent them from performing the tests safely and correctly were also excluded from the study. Participants were recruited by word-of-mouth, email, and flyers and signed an informed consent form prior to participation (See Appendix A). The consent form, along with any other information provided by the patient, was secured in a locked drawer within the research advisor’s office and the participant received a copy of the signed consent form.

**Instruments**

Theraband Kinesiology Tape, with XactStretch Technology (TheraBand, Akron, Ohio) was placed on the rhomboid muscles in both tape groups. Dartfish Motion Analysis Software version 6.0 (Dartfish Inc., Friborg, Switzerland) was used to analyze static postures for inclusion of participants and results of interventions, as well as dynamic postures throughout the exercises performed in the pre/post-test. All postures were recorded with a Canon VIXIA HF R400 camera (Canon U.S.A. Inc., Melville, New York). Other instruments included a resistance band with handles, which is an elongated rubber tube with attached handles that is used to provide mild to extreme resistance throughout a physical movement, and dumbbells for the strengthening protocol exercises (See Appendix B).

**Kinesio Tape Protocol**

Taping application followed the steps from the Theraband Kinesio Tape company. The participant stood, relaxed, with arms at sides. The skin was cleaned with an alcohol swab to remove lotions and oils. Adhesive spray was applied over the area before application. The
participant then actively protracted their shoulders, as far as possible, as if giving themselves a hug, and held the position to place the rhomboids on a stretch. KT was then applied. The specific Theraband Kinesio Tape that was used was printed with small hexagon shapes. Without stretch, the shapes had a thin, smooshed-like appearance, but when stretched to 50%, the shape took on perfect symmetry. This symmetry indicated to the researcher that the tape was stretched to 50%, or twice its original length. Each strip was measured from the vertebrae to the border of the scapula and then cut in half. The end of the tape was laid down with no stretch and the middle of the tape was the area that is stretched to 50%. The KT was applied one piece at a time, starting at the C7 vertebrae and stretching straight across the back, to reach the medial border of the scapula. After the first piece was laid down, it was rubbed to increase adhesion to the skin. The next two pieces were placed directly below the first using the same procedure. The taping was done bilaterally (See Appendix C). Once KT was applied, the participant relaxed into resting posture. Each participant was given instructions that aided in the proper care of the KT (See Appendix D).

**Placebo Tape Protocol**

The placebo tape consisted of the same type of KT that was used in the treatment group, except that it was applied without stretch. The skin was cleaned and adhesive spray was applied. The participant’s muscles were relaxed, with no stretch, while the strips of tape were applied to the rhomboids. The first strip was measured and cut to fit the length between the C7 vertebrae and the vertebral edge of the scapula. Three strips were placed on the rhomboids bilaterally and looked similar to the KT application.

**Static Postural Assessment**
Posture was assessed by using Dartfish Motion Analysis Software version 6.0 (Dartfish Inc., Friborg, Switzerland). Prior to video analysis, a mark was made on the most inferior portion of the earlobe and the acromion process. Before the strength protocol and the application of KT, a brief video was taken of the participant, relaxed and standing, portraying the RSP. The video was uploaded to Dartfish Motion Analysis Software version 6.0 (Dartfish Inc., Friborg, Switzerland) and analyzed. An angle was drawn with its axis starting at the mark on the most inferior aspect of the earlobe. One leg of the angle was straight down the body and perpendicular to the video screen. The second leg of the angle was bisecting the mark on the acromion process of the shoulder. The angle was measured by degrees and documented and used for analysis (See Appendix E).

**Dynamic Postural Assessment**

After the initial static posture assessment, the participant performed the strengthening protocol as a pre-test. During the strengthening protocol, on the last three repetitions of the last set of each exercise, a video was taken to assess RSP during each exercise. The last three repetitions were measured and averaged when analyzed. For each exercise, the video camera was placed in a position that best shows the RSP or any change in the RSP, whether the subject was lying down or standing. For all three positions, whether the participant was lying down (prone row) or standing (back fly and standing row), the camera was positioned to view the lateral side of the participant’s shoulder and ear. This lateral view was important to see the markers placed on the acromion and inferior ear lobe and gave a better view for any differences in RSP. Videos were uploaded to Dartfish Motion Analysis Software version 6.0 (Dartfish Inc., Friborg, Switzerland) and analyzed by using the same technique as the static posture analysis, except that the analysis occurred when the subject was relaxed before performing the exercise and again
when the subject was in the most contracted position, at the end of the exercise (See Appendix F). The average difference between relaxed posture reading and most contracted reading for three consecutive repetitions was calculated and used for measure. Measurements were recorded in degrees.

**Strength Protocol**

Participants were asked to perform the strengthening protocol for the rhomboid muscles which consisted of three rhomboid strengthening exercises, before and after application of KT, as a pre-test. Exercises included the standing “row” and the single-arm prone “row,” both taken from the study by McGarvey,\(^{15}\) and a standing back fly. Both the standing row and back fly used the resistance band and the prone row used a five-pound dumbbell (See Appendix B). All three exercises were done for three sets of ten repetitions each; each repetition was held for three seconds in the contracted position. All exercises that used the resistance band used mild to moderate resistance and the “prone row” used a dumbbell. Each participant, in both the control and treatment groups, performed the strengthening protocol, as a home exercise program, twice a week for two weeks with the KT. Each session took approximately one hour.

**Overall Procedure**

All testing was done in the Marietta College Athletic Training Facility.

The participant limited distractions, such as technology, and came prepared and wearing the appropriate clothing. The participant also allotted him or herself at least 60 minutes per session to be able to finish the study appropriately. The participant alerted the investigator of any previous allergies to adhesive or KT, if not already reported while signing the informed consent. Bands and weights were checked prior to each pre-test and post-test of the study. The participant
arrived wearing clothing that revealed the upper back (if comfortable, males went shirtless and females wore a tank top that had thin straps, so that the upper back was exposed).

The inferior ear lobe and acromion process, of both sides of the body, were marked with stickers. Each participant stood against a plain backdrop, relaxed with arms at their side, and a brief video was taken to analyze static posture. They then performed a pre-test. Three exercises were performed—the standing back fly, the prone row, and the standing row. Each exercise was performed in three sets of ten repetitions. Videos were taken on each exercise, for both sides of the body, for the last three reps of each set. Following the exercises, the participant was randomly assigned to either placebo tape or KT, by rolling a dice. The control group received the placebo taping, which was the KT applied without a stretch, and went through the strength protocol twice a week for two weeks. The treatment group received KT applied with a stretch and performed the strength protocol twice a week for two weeks. The placebo or treatment tape was applied per the taping protocols described above. Another brief video of static posture was taken. The participant then, with the tape on, performed the three exercises again. Videos were taken again of the last three repetitions of each set. After the pre-test was complete, all videos, both static and dynamic were uploaded and analyzed in Dartfish Motion Analysis Software version 6.0.

Following the pre-test, the participant completed the strength protocol, using a dumbbell and resistance band that they personally owned, or equipment in the Dyson Baudo Recreation Center located on the Marietta College campus. All participants completed the protocol twice a week for two weeks, all while keeping the tape on their rhomboids. At the end of the two weeks, on the participant’s final protocol session, the participant performed a post-test with the researcher. The post-test consisted of the participant performing the exercises one more time,
while final videos for dynamic postural assessment and static postural assessment were taken. The post-test videos were uploaded to Dartfish Motion Analysis Software version 6.0 for assessment with measurements noted in degrees. Once all the videos from both pre-test and post-test were analyzed, a final assessment of changes in posture over the two-week period was made. Overall, an average of five to six hours was committed by each participant, which included the pre-test, post-test, and each individual strength protocol session.

Moderate risks included an allergic reaction to the KT, skin irritations from the adhesive, and soreness on area of skin where the tape was taken off. Low risks included any harm from the bands or dumbbells, due to the potential accident of snapping a band or dropping a weight onto a body part as well as any soreness/tightness in muscles from the constant facilitation of the rhomboids.

**Statistical Analysis**

The independent variables of this study were the placebo taping and KT while the dependent variable included the static posture. The number of participants was determined by G Power which suggested that 54 participants should be included in the study to reach statistical significance. IBM SPSS 20.0 (Armonk, NY) was used to employ a mixed-model ANOVA with a repeated-measures factor to look for statistical difference between the control and treatment group, and for any significance across time, when KT and strengthening were combined. The pre-test, post-test, and the second post-test (post-strength protocol) static measurements were used within the repeated-measures factor and represented as STATICPRE, STATICPOST, and STATICPOST2 within the data.

**RESULTS**

A total of 11 participants with RSP (6 male, 5 female, age 28.8 ± 13.0 years) completed the study (Table 1). One participant was excluded one week after beginning the study, due to an
allergic reaction to the KT. To assess differences when combining KT and strengthening, a mixed-model ANOVA was used, with a repeated-measures factor of time of measurement (STATICPRE, STATICPOST, STATICPOST2) and a between-subjects factor of experimental versus control condition. Left and right-side measurements of both taping groups were compared (Table 2, Graph 1, Graph 2). There was no significant effect when comparing the experimental and control condition of the right side of the body (F(1, 9) = .06, p = .808) or the left side of the body (F(1, 9) = .04, p = .850). There was no significant effect for time within each subject on both the right side (F(2, 18) = .28, p = .762) and the left side (F(2, 18) = 2.08, p = .154). Lastly, there was no significant interaction within the between-subjects factors of taping conditions and the repeated-measures factor of time in both the right side of the body (F(2, 18) = .16, p = .855) and the left side of the body (F(2, 18) = .35, p = .710).

**DISCUSSION**

With the combination of the KT and strength protocol, there was no significant change in RSP over time. While the results of this study were not significant, there are several trends that relate to previous research on KT and the facilitation of muscle\textsuperscript{8,9,10,11,15} as well as strengthening.\textsuperscript{15}

The first trend to note is the baseline (STATICPRE) measurements for both right and left side (Table 2, Graph 1, Graph 2). All participants had RSP in only one shoulder, which was the left shoulder. The average baseline measurements for the left shoulder were positive which meant the acromion was sitting in front of the inferior ear lobe. However, the baseline measurements for the right shoulder were negative, meaning the acromion was already sitting behind the inferior ear lobe, indicating present retraction of the shoulder. This trend was expected as all participants, but one, were right side dominant. This dominance indicates more musculature, and overall greater strength, in the right shoulder.
When looking at how KT, combined with strengthening, affected RSP over time, there are trends to note within the data. Overall, there were improvements in RSP from baseline (STATICPRE) to final (STATICPOST2) measurements in both the right and left sides of the body. This can be seen by observing the mean averages (Table 2, Graph 1, Graph 2). The improvement, although small, was observed in both placebo and experimental groups, indicating that the shoulder progressively realigned with the inferior ear lobe, or moved further behind the ear lobe. The experimental group also had greater changes in RSP over time than the placebo group. Therefore, over time, KT facilitation, combined with strengthening, had a greater positive effect on RSP than strengthening combined with a placebo taping.

Several previous studies, focusing on KT alone or KT with strengthening, have supported the trend mentioned above. Nakajima et al\textsuperscript{9} focused on the lower extremity and applied KT over the triceps-surae muscles. Nakajima et al\textsuperscript{9} performed their study to compare differences in vertical jump height, as well as changes in dynamic postural control using the Star Excursion Balance Test. While there were no significant changes in vertical jump height, there were significant improvement in scores of the Star Excursion Balance Test with females, after the KT was worn for 24 hours.\textsuperscript{9} This finding relates to the current study in that KT was worn with stretch, over a period of time, and the experimental group had a greater change in improvement over time. However, in the current study, the KT was used to facilitate a deeper muscle and was worn over two weeks which could have been the cause for lack of significance in the results.

Alvarez et al\textsuperscript{10} and Zanca et al\textsuperscript{11} both examined KT facilitation to reduce muscle fatigue. Alvarez et al\textsuperscript{10} examined effects of KT in muscle fatigue over the trunk extensor muscles during a Biering-Sorensen test.\textsuperscript{10} There was a significant difference in times achieved with the KT facilitation group versus the control group.\textsuperscript{10} The KT group also performed better than the
placebo group, although no significance was noted.\textsuperscript{10} These findings relate to the current study in that they indicate an influence of KT on muscle fatigue. The current study found greater changes in the experimental group, who had KT with stretch and strengthening. Zanca et al\textsuperscript{11} studied the effects of KT on scapular kinematics following muscle fatigue in overhead athletes through a cross-over design.\textsuperscript{11} Participants underwent a throwing protocol to induce muscle fatigue in each scenario; KT tape, sham tape, and control, while EMG activation was measured in the serratus anterior and upper and lower trapezius muscles.\textsuperscript{11} While there was no significant decrease in muscle fatigue in study,\textsuperscript{11} the results showed significant decrease in EMG frequency of the serratus anterior muscle when comparing KT and sham groups.\textsuperscript{11} This indicated a lower intensity produced by the serratus anterior, during throwing, when KT with stretch was applied.\textsuperscript{11} There were also some small changes in scapular kinematics (movement) between all three taping conditions, but none that were considered significant.\textsuperscript{11} These results indicate some effect of KT on muscle fatigue which relate to the current study as a possible explanation for the greater changes in RSP with the experimental group. However, Zanca et al\textsuperscript{11} focused on overhead athletes while the current study included the general population. Zanca et al\textsuperscript{11} also had access to an EMG to note strength and location of muscle activation while the researcher of the current study did not. Zanca et al\textsuperscript{11} concluded that overhead athletes could have an adaptive mechanism that limits change in scapular kinematics following muscle fatigue.

Meyer\textsuperscript{4} also studied the effects of KT on strength. There was an experimental and a control group for the application of KT and each participant was allocated to both groups over two weeks.\textsuperscript{4} The participants performed isometric strengthening trials for three days, while wearing KT on the upper trapezius muscle of their dominant side.\textsuperscript{4} There was no significant difference between tape groups, but the study claimed significant improvement in shoulder
strength after three days.\textsuperscript{4} Meyer\textsuperscript{4} suggested that there could have been a learning effect throughout the study which could explain the results in increased strength levels. This relates to the results of the placebo group in the current study, in that there was an improvement in RSP over time. McGarvey’s study\textsuperscript{15} focused on finding exercises for certain upper body muscles, that elicited the most EMG activity. The row, both prone and standing, were two exercises that had the highest EMG activity for the rhomboid muscles.\textsuperscript{15} This relates to the study in that both exercises were used for the strength protocol and the improvement in RSP for the placebo group could suggest an appropriateness in the choice of exercises.

Another explanation for the placebo group results is the concept of muscle hypertrophy (growth of muscle size). Brummitt et al\textsuperscript{18} discuss the adaptations of muscles and tendons to strengthening and conditioning. There are several muscular adaptations that occur due to resistive training, one being an increase in neural stimulation.\textsuperscript{18} Improvements in neuromuscular control during training are the cause of early muscle strength gains and hypertrophy.\textsuperscript{18} Hypertrophy, an enlargement of a muscle, is caused by an increase in physiological cross-sectional areas of skeletal muscle.\textsuperscript{18} These areas can only be seen in diagnostic imaging and muscle growth typically isn’t seen until a couple months into a training program.\textsuperscript{18} Therefore, if the strength protocol in the current study occurred for a longer period of time, further strength gains could have been noted, as well as a possible significant improvement in RSP.

All three studies\textsuperscript{10,11,4} are relevant to the current study in that both placebo and experimental groups improved in RSP measurements over time. Therefore, the KT could have aided in decreasing muscle fatigue throughout the strength protocol which would support the greater changes in the experimental group. Strengthening alone also produced improvements in RSP over time for the placebo group. This could indicate a learning effect as Meyer\textsuperscript{4} concluded,
as well as further support the known physiological theory of muscle hypertrophy and strength gains. Nevertheless, the current study had a very small number of participants in comparison with the studies above and therefore the trends seen in the data could have held significance with a higher number of participants.

The last observation to note is the difference in \( p \) values between the left and right side, when comparing significance over time, within the repeated-measures factor. The left side was much closer to significance \( (p = .154) \) than the right side \( (p = .762) \). The current study’s observation could be due to a dominance factor. While all but one participant was right-side dominant, all the participants had RSP only in the left shoulder. This indicates that overall, the weaker, non-dominant shoulder presented with poor posture and yet improved the most. Since Nakajimo et al., Zanca et al., and Meyer all applied tape to the dominant side of each participant there has been no comparison of dominance to non-dominance and how KT, or KT and strengthening could play a role. This trend could be the basis for future research on comparing non-dominant to dominant neuromuscular reactions to KT or KT with strengthening.

**Limitations**

The lack of significance in the findings of this study may be due to several limitations. The sample size was small compared to the suggested sample size of 54 determined by G Power. The lack of participants may have hindered the ability to determine significant change between groups and over time. Most participants claimed that the KT caused itchiness and discomfort. This itchiness often occurred after the tape became wet, either from showering, swimming, or sweating. One participant was excluded from the study, after wearing the tape for a week, due to forming a rash from itching the rhomboid muscle area. Another limitation included the researcher needing to educate several participants on how to perform the exercises in the pre-test. Several participants had lack of experience with strengthening and the researcher was unable to
monitor their form throughout the entire protocol. Also, the participants completed the strength protocol sessions on their own. While the researcher kept track of each participants completion of each protocol session, there was no direct supervision to note if proper form was being maintained throughout each exercise session. Another limitation includes the length of the strength protocol. Having only 4 exercise sessions, from the pre-test to the post-test, could have led to a lack of time for proper increase in weight/resistance and muscle hypertrophy. There was also no access to EMG. As a result, there was no way to know if there was more neuromuscular facilitation on the non-dominant side. Lastly, the researcher had no certification in KT application and there was difficulty tracing the rhomboid muscles. The rhomboid muscles are deep to the trapezius muscles and therefore are unable to be seen without extreme hypertrophy or enlargement of the muscle.

CONCLUSION

The purpose of this study was to investigate the effects of KT facilitation combined with strengthening on the rhomboid muscles to improve RSP. Analysis of the data indicates that KT, in combination with strengthening, is not effective in correction of RSP in the two-week time frame described in the current study. However, with the trends in the data, this study could be the basis for future research investigating the differences in non-dominant to dominant sides of the body with the use of KT, as well as using the combination of KT and strengthening for a longer period of time.

Future Research

Future research should include a longer strength protocol, as well as a strength protocol that includes more exercises to further stimulate muscle hypertrophy. Other research could also expand the population sample by including adolescents and elderly adults. Lastly, further
research could incorporate comparison of the use of KT on non-dominant to dominant sides of the body.
REFERENCES


APPENDIX A: Recruitment details, informed consent

Figure 1: email sent to students and faculty of Marietta College

Marietta College Students AND Faculty,

My name is Elena Robinson and I am a senior here at Marietta College, pursuing an Athletic Training major. I am currently working on a research study and I am in need of participants! The title of my study is, “The Use of Kinesio Tape, with a Strengthening Protocol, in Aiding Scapular Retraction Through Facilitation of the Rhomboids.” This study is focusing on a posture called “rounded shoulder posture” which is a common issue among those who sit in front of technology, such as computers, for long periods of time. The purpose of the study is to examine the effects of kinesio tape on the rhomboid muscles of the upper back, as well as to see how a strength protocol, combined with the kinesio tape, can affect the rounded shoulder posture as well. If you are interested in joining this study, please see below for more details!

- Participants need to be 18 years or older.
- Participants are needed ONLY if they have rounded shoulder posture.
- This study entails kinesio tape being applied to the upper back area, on the rhomboid muscles.
- After taping, a pre-test will be taken of three exercises: the row (laying down), the standing back-fly, and the standing row. Each exercise will be completed in 3 sets of 10 reps.
- After the pre-test, the participant MUST complete the strength protocol, which consists of the same exercises. The protocol will take no longer than 1 hour, twice a week, for two weeks. A post-test will be taken to examine any changes.
- ONLY 5 hours of your time is needed!

Participants will be excluded from the study if they have history of an upper extremity injury of a fracture or a dislocation in the past 6 months, a history of neck or shoulder surgery, neurological or cardiac pathologies or any allergic reaction to the KT. A participant that has any spinal deformities such as Sprengel’s deformity, scoliosis, kyphosis, spondylolysis, spondylothesis, and any other injuries pertaining to the spine that prevent the subject from performing the tests safely and correctly will also be excluded from the study.

This study has been approved by the Marietta College Human Subjects Committee. If you are interested in joining this study, please contact me at enr004@marietta.edu OR 740-885-0929 (text/call)!! Your time and dedication would be greatly appreciated.

Thank you,

Elena Robinson
Figure 2: flyer posted around Marietta College campus housing

I am currently an Athletic Training major and am currently searching for participants for my research study this fall!

- Participants need to be 18 yrs. or older.
- Participants needed if they have rounded shoulder posture (when the shoulder(s) rest in front of the ear lobe, usually caused by poor posture). Participants will be evaluated for the posture and if positive, will be invited to participate in the study.
- Exclusion criteria includes: history of upper extremity injury (fracture/dislocation) in the past 6 months, history of neck or shoulder surgery, neurological/cardiac pathologies, any allergic reaction to the kinesio tape, spinal deformities and any other injuries that prevent the subject from performing the tests safely and correctly.
- This study entails kinesio tape being applied to the upper back area, on the rhomboid muscles.
- After taping, a pre-test will be taken of three exercises: the row (laying down), the standing back-fly, and the standing row (3 sets/10 reps).
- After the pre-test, the participant MUST complete the strength protocol, which consists of the same exercises. The protocol will take no longer than 1 hour, twice a week, for two weeks.
- A post-test will be taken to examine any changes.
- No more than 5 hours of your time is needed.

If interested or simply want more information, contact me! (contact info above)

*This study has been approved by the Marietta College Human Subjects Committee*
Figure 3: first page of informed consent, read and signed by participants before beginning the study

Informed Consent Document

Elena Robinson
earo04@mar.edu
740-885-0929

This research has been approved by the Marietta College Human Subjects Committee.

Purpose
The purpose of this research study is to examine the immediate effects of Kinesio Tape facilitation of the rhomboid muscles on static rounded shoulder posture as well as dynamic postural changes when Kinesio Tape facilitation is combined with a strength protocol focused on the rhomboid muscles. A minimum of 54 subjects, that have rounded shoulder posture, will be used.

Confidentiality of records, that identify you, will be maintained and secured within the research advisor’s office, and all data will be used for research purposes only. Data will be kept for a minimum of three years before being disposed. Participation is voluntary and refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Exclusion Criteria
Participants will be excluded from the study if they have history of an upper extremity injury of a fracture or a dislocation in the past 6 months, a history of neck or shoulder surgery, neurological or cardiac pathologies or any allergic reaction to the Kinesio Tape. A participant that has any spinal deformities such as Sprengel’s deformity, scoliosis, kyphosis, spondylolisys, spondylothesis, and any other injuries pertaining to the spine that prevent the subject from performing the tests safely and correctly will also be excluded from the study.

Procedure
- All testing will be done in the Marietta College Athletic Training Facility. You will only perform this study once.
- You will be expected to participate in the research study for about one hour, twice a week for two weeks.
- You must come prepared with appropriate clothing that bares the upper back and limit all distractions, such as technology.
- A pre-test will be completed that consists of the application of Kinesio Tape and the strength protocol.
- The strength protocol will last two weeks. To complete the protocol, you must be able to perform all three exercises, the prone single arm row, standing row, and the standing back fly, for three sets of ten repetitions, twice a week for two weeks. Illustrations of each exercise can be performed before consenting to the study.
- You will need to wear the Kinesio Tape at all times for the two weeks that you will be tested. There will be a post-test with the strength protocol as well.
- You must allow videos to be taken for static and dynamic posture assessment and analyzed.

Debrief
The main goal of this study is to see how Kinesio Tape or strengthening exercises, or both, can affect one's upper body posture and the posture that is being concentrated on is the rounded shoulder posture. Kinesio Tape is a type of tape that has great elasticity and is used for rehabilitative purposes. Rounded shoulder posture is noticeable when the shoulder(s), specifically the acromion process, lays in front of the ear lobe. This type of posture is often seen in people who sit in front of technology, or at a desk, for long periods of time. Hence, a college/university is a great place to see an array of people who could possibly have rounded shoulder posture. With your consent, this study will have you wearing Kinesio Tape while performing the three exercises mentioned above for two weeks. Both the tape and the exercises are targeting the rhomboid muscles, which are important in keeping your scapulae (shoulder blades) retracted. If you have rounded shoulder posture, most likely you have weak rhomboid muscles which is where the tape and exercises aid in the study. The tape is being used to facilitate the movement of the rhomboids and to help retract the scapulae while the exercises are being used to strengthen the rhomboids. By the end of the two weeks, improvement in the rounded shoulder posture will hopefully be seen. Although there are no specific benefits to this study, learning more about Kinesio Tape and strengthening exercises as well as being more aware of your posture can be personal benefits gained by completing this study.

Risks

Moderate risks include allergic reaction to the Kinesio Tape, skin irritations from the adhesive, and soreness on the area of skin where the tape is taken off. If you are, or may think you are experiencing an allergic reaction, then contact the investigator of the study at Marietta College’s Health and Wellness Center. All contact information is listed in the instructions for proper care of the Kinesio Tape. Low risks include any harm from the bands or dumbbells, due to the potential accident of snapping a band or dropping a weight onto a body part could be a potential danger as well as any soreness/tightness in muscles from the constant facilitation of the rhomboids. You must alert the investigator of any previous allergies to adhesive or Kinesio Tape. Bands and weights will be checked prior to each session of the study. You can also utilize the Athletic Training Room’s modalities to decrease muscle soreness or tightness.

There are no benefits to the study except that the rounded shoulder posture might be changed. No alternative procedures or treatments will be used.

You may contact Jaclyn Schwieterman if you have any questions or concerns about your rights as a research subject. Jaclyn Schwieterman, Marietta College Human Subjects Committee Chairperson, at ssi004@marietta.edu OR 740-376-4773.

You may also contact the research advisor of this study, if you have further questions. Christen Regehr at ckh005@marietta.edu.

☐ Please check the box if you have never been diagnosed with any of the exclusionary conditions.

By signing below, you agree that you have had time to read the informed consent document, ask questions, and are voluntarily consenting to this study.

Print ___________ Sign ___________ Date _______
APPENDIX B: Tools for strength protocol

Figure 1: Resistance band with handles

Figure 2: Dumbbell
APPENDIX C: Finished KT application
APPENDIX D: Kinesio tape care instructions

Instructions for Proper Kinesio Tape Care

- Wearing the Tape
  - Can be worn up to five days
  - May shower, exercise and swim
  - Use a towel to pat dry after getting it wet
  - Avoid rubbing the tape
  - Do not use a hair dryer to dry the tape

- If the tape is not staying or you are having an allergic reaction to the adhesive/KT, please contact the investigator of the study or contact Marietta College’s Health and Wellness Center.
  - Elena Robinson: ear004@marietta.edu OR 740-885-0929
  - http://www.marietta.edu/center-health-and-wellness

**Please DO NOT take the tape off UNLESS you are having an allergic reaction! It is important that the kinesio tape be worn at all times for this study, until instructed otherwise. Thanks!**
APPENDIX E: Static postural assessment

Figure 1: Left side – angle measurement of RSP, acromion is in front of the ear lobe and represents a positive measurement, qualifies the subject for participation

Figure 2: Right side – angle measurement with no RSP, acromion is behind the ear lobe and represents a negative measurement
APPENDIX F: Dynamic postural assessment and exercises of strength protocol

Figure 1: Prone row, relaxed position

Figure 2: Prone row, contracted position
Figure 3: Standing row, relaxed position

Figure 4: Standing row, contracted position
Figure 5: Standing back fly, relaxed position

Figure 6: Standing back fly, contracted position
APPENDIX G: Tables and graphs

Table 1: Demographics for taping groups

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<td></td>
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<tr>
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Table 2: Descriptive statistics for right and left side measurements – change over time

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Graph 1: Comparison of experimental and placebo means for right shoulder measurements over time

Graph 2: Comparison of experimental and placebo means for left shoulder measurements over time