INTRODUCTION

Ideal posture gives the spine a neutral balance point between antagonistic muscles and requires minimal muscle activity to maintain. Kendall et al [1] describes the standard points of reference for ideal upper body posture as a line of gravity through the center of the ear lobe, the seventh cervical vertebra, and the acromion process. With a shift away from the ideal, as is seen in forward head/ rounded shoulders posture (FHRSP), a muscular imbalance develops, which can lead to more serious pathologies. Cumulative trauma disorder (CTD) refers to any injury caused by repetitive micro trauma, such as the headaches or cervical, shoulder, and thoracic pain incurred with prolonged FHRSP. The high incidence of such injuries has lead CTDs to be identified as "the workplace disorder of the 1990's." [2] Therapeutic exercises are common interventions used to treat or prevent the CTDs caused by poor posture.

Kinesio Tex Tape®, created in 1996 by Kase[3], is commonly used in clinical practice in conjunction with other interventions to treat a wide variety of impairments, including FHRSP. Its key characteristic is its elasticity, which allows the product to expand to 130-140% of its resting length. It is theorized that Kinesio Tex Tape® creates convolutions in the skin that increase the interstitial space, allowing increased venous and lymphatic flow. In addition to these primary effects, Kinesio Taping® is also theorized to facilitate normal movement, decrease pain, promote circulation and healing, improve stability, and facilitate proper alignment.[4] However, there is little research on its benefits anywhere in the body, and none could be found specifically on its effects on posture.

FHRSP is exacerbated by lifestyles that require the person to sit for prolonged periods of time or repeatedly assume a forward flexed sitting position.[5] Poor posture is an adaptation from a habit of spending large amounts of time in these positions, such as college students sitting in classes for numerous hours every day. To correct FHRSP, it is important to not only correct the resulting muscular imbalances, but to go to the source of the problem and prevent FHRSP from occurring. In theory, Kinesio Tex Tape® could be applied for "enhancing proprioception" and therefore "facilitating joint and muscle realignment". This would help the person maintain a prolonged correction to their posture.[4]

Statement of Purpose

The purpose of this study was to look at the effects of Kinesio Taping® on FHRSP as part of a therapeutic exercise program. These interventions are commonly used to treat the underlying posture that leads to CTDs in the neck, shoulders, and upper back.

Hypothesis

It was hypothesized that the correct application of Kinesio Tex Tape ®, as part of a therapeutic exercise program, would result in significantly reduced FHRSP compared to placebo and control groups.

Limitations

The use of a home exercise program (HEP) made it difficult to monitor subject compliance and ensure they were using proper techniques. In addition, some subjects were participating in a personal exercise program at the beginning of the study, and although the importance of not altering their program during the course of the study was stressed, it is not certain that they were compliant with this request. Thus, any changes in their personal exercise

programs could have been responsible for any changes noted in their forward head and rounded shoulders.

Another factor which limited this study was the Kinesio Tex Tape® itself. Many subjects reported itching and other minor discomforts, as well as a reluctance to participate for cosmetic reasons since the product we used was black and the study was conducted during the summer. It was also noted that some subjects had greater difficulty keeping the Kinesio Tex Tape® on than others, even with proper skin preparation and the addition of a spray adhesive.

Review of Literature

Normal posture is defined as a balance point between antagonistic muscles that requires little muscle activity to maintain. [6] To maintain FHRSP, the muscles are forced to contract constantly, resulting in a build-up of catabolites that can cause pain and stiffness in the tense neck and shoulder muscles. [7] With a chronic flexed posture, there is adaptive strengthening and shortening in certain muscles with lengthening and weakening of the opposing muscles. [8] The typical pattern consists of weak deep neck flexors, rhomboids, serratus anterior, and lower trapezius, with the opposing strong muscles typically including the pectoralis major and minor, upper trapezius, and levator scapulae.[9]

Griegel-Morris et al[6] looked at a sample of 88 healthy individuals 20-50 years old and assessed their posture using a plumb line and gave them a questionnaire regarding any resulting pain in the thoracic and cervical spine and shoulders. They found that 66% demonstrated a forward head posture, 73% had a right rounded shoulder, and 66% had a left rounded shoulder. They also noted that subjects with more severe FHRSP had an increased incidence of pain.

Even more alarming is how frequently these problems are seen in younger populations, since it's suggested that problems at a young age may lead to more serious consequences later in

life.[5] In one study of 250 undergraduate students, the average age of onset of neck problems was 17.4 (± 3.4) years, and the prevalence increased substantially from the first year students to the second year students, a pattern which continued with the fourth year students.[10] Several factors that may contribute to these findings include poor sitting posture, poor workspace ergonomics, sedentary lifestyle outside of work/school, and a lack of postural awareness.[5, 6]

While FHRSP may seem benign, it can lead to more serious pathologies. Common examples include headaches and neck and upper back pain.[9, 11] In the shoulder, the ramifications of FHRSP include decreased range of motion (ROM) and decreased strength. In one study measuring shoulder ROM and strength in a slumped position, they found an average decrease of 23.6^{o} of shoulder abduction and a 16% decrease in horizontal abduction strength. They also noticed the resting position of the scapula was more elevated compared to sitting upright.[12] This change in scapular position, which also commonly includes protraction, alters normal scapulohumeral rhythm. Disruption of scapular movement often leads to a decrease in the size of the subacromial space and subsequent impingement or tearing of the tendons of the rotator cuff and the long head of the biceps.[8]

There are a variety of treatments used to improve poor posture, including therapeutic rollers, the Feldenkrais method of Awareness Through Movement, and therapeutic exercise. One study looked at the effects of therapeutic rollers in improving FHRSP. The amount of forward head was measured using a CROM device and the amount of rounded shoulders was determined by measuring the distance of the acromion off the table with the patient in supine. All subjects were given a home exercise program and divided into control and experimental groups. The control group performed the exercises lying on the floor and the experimental group lay on a therapeutic roller. Their FHRSP was re-assessed after two weeks. There was no significant

difference between groups for forward head posture (p=.446) or left forward shoulder (p=.051), but there was a significant decrease in right forward shoulder in the therapeutic roller group (5.1cm pre-test and 4.3cm post-test, p=.018). These results do not strongly support the use of therapeutic rollers in treating FHRSP, but may be affected by the small sample size (n=41) or the short duration of the study. [13]

The Feldenkrais method improves posture using the concept of Awareness Through Movement. In this technique, the subject is guided through their faulty movements, helping them move correctly and fluently, becoming more aware of what is occurring at each joint. This is hypothesized to lead to the development of new, correct postural habits, which can cause an improvement in muscular imbalances, quality of movements, and pain reduction. [14]

According to Jain et al[14], there are few well designed studies supporting the benefits of the Feldenkrais method. Ruth and Kegerreis[15] looked at the effects of the Feldenkrais concept of Awareness Through Movement on neck flexion ROM. Twenty-eight subjects with no history of neck problems were randomly assigned to a control or experimental group. Both groups were pre-tested with a cervical goniometer to measure the amount of motion as they flexed their head off the table from a supine position. The control group was instructed to entertain themselves for fifteen minutes, while the experimental group performed an Awareness Through Movement sequence aimed at training the deep neck flexors. The same measurements were then repeated and 50% of the experimental group showed an increase in ROM greater than 5^{o}, while only 14% of the control group saw the same improvement. A Rating of Perceived Exertion (RPE) was also included in the pre and posttest measurements to assess how much effort it took to lift the head off the table. Seventy-one percent of the experimental group reported a decreased RPE during the posttest measurements, compared to only 14% of the control group. Thus, the authors

concluded that the study supported their hypothesis that the Feldenkrais method of Awareness Through Movement can increase the amount of neck flexion and decrease the amount of effort required to complete the task. They do note, however, that their sample size was small and more studies are needed to validate this method. [14]

It is widely believed that people with FHRSP can profit from therapeutic exercise directed at postural muscles. [16] It is theorized that by stretching tight muscles and strengthening the opposing weakened muscles, proper balance can be re-established between muscle groups. One study by Falla et al[11] looked at the effect of neck exercises on forward head posture during sitting. Fifty-six subjects with chronic neck pain defined by a Neck Disability Index score less than 15 started sitting at a computer in upright posture using a plumb line. There was also a control group of subjects with no history of neck pain or injury. The subjects were asked to maintain the upright posture while playing a game for ten minutes. Subjects in the control group showed no significant postural changes during that period, while subjects in the experimental group showed a significant change in cervical angle ($P<.001$) and thoracic angle ($P=<.01$). The subjects in the experimental group were then assigned to two groups. In the first group the subjects did craniocervical flexor strengthening exercises, and in the second group the subjects did endurance and strengthening exercises for the cervical flexors. After six weeks, the subjects were re-assessed and there was a significant decrease in pain and an increased ability to maintain upright posture for both intervention groups. The craniocervical flexor group also saw a significant improvement in cervical angle compared to the endurance-strength cervical flexor group. This suggests that improvements in posture can be obtained through a strengthening program. [11]

In another study by Roddey et al[17] the effect of pectoralis minor stretching on rounded shoulder posture was examined using the Total Scapular Distance. Forty subjects were randomly assigned to either the control group or the stretching group. The latter participated in a pectoralis minor stretching program for two weeks, at the end of which all subjects were re-evaluated. A significant difference was found in FHRSP of the subjects in the stretching group compared to the control group, suggesting that stretching plays an important role in correcting posture.

Benedict and Brigner's[18] study looked at the effect of a therapeutic exercise program in decreasing rounded shoulders posture, and consisted of three treatment groups. Group 1 did anterior chest and shoulder stretches, group 2 did posterior strengthening exercises, and group 3 did both exercise programs. Data analysis showed that all three groups had an improvement in scapular position, but there was no significant difference between the groups. This indicates that stretching and strengthening exercises are beneficial in the correction of rounded shoulders posture whether done alone or together.

For stretching to be effective in increasing muscle length, it must be maintained for an appropriate amount of time. Bandy et al[19] examined the effects of different durations of stretching programs to determine which is the most effective. They took ninety-three subjects age 20-40 years with at least a thirty degree loss of knee extension in the 90/90 position and divided them into five groups. Group 1 did three 60 second stretches, group 2 did three 30 second stretches, group 3 did one 60 second stretch, group 4 did one 30 second stretch, and group 5 was a control group and thus didn't participate in a stretching program. After 6 weeks, all subjects were re-evaluated and they found there was a significant difference between the control group and all four experimental groups, but not between the individual stretching groups.

The authors concluded that stretching for longer than 30 seconds does not produce significant changes.

There are many ways of measuring forward head posture. The intertester and intratester reliability of the Cervical Range of Motion instrument was examined by Capuano-Pucci et al[20] in a sample of twenty volunteers with no history of cervical problems. After performing three repetitions each of cervical flexion, extension, rotation, and lateral flexion, two measurements were taken for each movement on each subject. The device was removed and then re-applied by the second tester who repeated the measurements. All subjects returned to be re-tested two days later and the process was repeated. Intratester reliability coefficients ranged from .63 to .91 for the first tester, and from .62 to .91 for the second tester. Intertester reliability coefficients ranged from .80 to .87, which was considered to be very reliable by the authors. While it seems odd that intertester reliability was superior to intratester reliability, the measurements taken between testers were only a few minutes apart, while the measurements taken by the same tester were two days apart, which could account for the increased variation. Regardless, the CROM instrument demonstrates good intra and intertester reliability and thus is a valid assessment tool.

The validity and reliability of the T-bar, or Baylor Square, for measuring forward shoulder posture was examined in a study by Peterson et al.[21] Measurements taken using a T-bar were compared to those taken from radiographic images. Data was collected from forty-nine subjects and the ICC showed the intrarater reliability to be .91, which is statistically significant and indicates the T-bar is a reliable measure in the assessment of forward shoulder posture.

As mentioned previously, there is limited research on the effects of Kinesio Tex Tape®. In one study, Slupik et al[22] examine the effect Kinesio Tex Tape® has on peak torque of the vastus medialis in twenty-seven healthy participants. In Protocol 1, transdermal EMG was used

to assess peak torque prior to tape application, and then at ten minutes, twenty-four hours, seventy-two hours, and ninety-six hours after application. The results showed that after ten minutes there was not a significant change in peak isometric contraction. However, after twenty-four hours there was an average of 54% increase from baseline electrical activity and after seventy-two hours it was still 22% higher than baseline. After four days there was no longer a statistically significant rise in electrical activity. Protocol 2 examined the electrical activity in the vastus medialis prior to the Kinesio Tex Tape® application and again after twenty-four hours. The tape was then removed and electrical activity was reassessed after an additional forty-eight hours. Their results showed that average peak torque increased by 89% after a day and two days after removing the tape it continued to increase to 102% of the baseline measurement. This data suggests that Kinesio Tex Tape® affects muscle tone gradually over several hours rather than immediately after application and lasts no more than three or four days whether the Kinesio Tex Tape® has been removed or not.

This was in agreement with the results of another study looking at the effects of Kinesio Taping® on hamstring and quadriceps strength in post-operative ACL patients. Murray[23] found that there was an increase in EMG measurements compared to no tape and athletic tape groups immediately following application, as well as an increase in range of motion.

However, in yet another study looking at the effect of Kinesio Taping® on the isokinetic strength of the quadriceps and hamstrings muscle groups of fourteen healthy athletes, strength was assessed prior to taping, immediately following the Kinesio Tex Tape® application, and again twelve hours later. There was not a statistically significant difference found between the three measurements, indicating that the Kinesio Tex Tape® was not effective in increasing muscle strength. It should be noted the study had a small sample size, worked with healthy

subjects, and did not look at the long term effects of Kinesio Taping®, with the longest duration of application being 12 hours.[24] Further studies are needed to examine the other uses of Kinesio Tex Tape®, including its effects on acute injuries, pain, improving microcirculation, and altering proprioceptive input.

A 1999 study examined the effects of Kinesio Taping® on biceps muscle strength, elbow range of motion, pain, circumference, levels of creatin kinase in the blood, and ultrasound measurements of muscle thickness following eccentric exercise. Compared to the control group, there was only a statistically significant difference in maximal isometric force of the biceps, indicating that the Kinesio Tex Tape® had an effect on strength, but not pain, range of motion, circumference, blood levels, or muscle thickness.[25]

Murray[26] conducted a study on twenty-six subjects to determine the effects of Kinesio Taping® on ankle proprioception at various angles compared to athletic tape and no tape conditions. Results showed the Kinesio Taping® group had a statistically significant difference at 10^{o} of plantarflexion, but not in the other two angles (26^{o} of plantarflexion and 8^{o} of dorsiflexion). It is unknown why improved proprioception in one position and not the other two, demonstrating the need for further research on the effects of Kinesio Tex Tape® in improving proprioception.

There have also been several studies examining the ability of Kinesio Taping® to reduce pain. Thelen et al tested this theory in college students with shoulder pain and found an immediate improvement in their pain-free abduction range of motion, but no change in their pain intensity.[27] Brandon and Paradiso[28] on the other hand found that all three patients in their case study with patellofemoral pain syndrome were able to ambulate pain-free immediately following Kinesio Taping®.

Summary

Due to the many ramifications and the high incidence of FHRSP, it is important to find the most successful interventions to correct it. While there has been research into the benefits of therapeutic exercise, therapeutic rollers, and the Feldenkrais method of Awareness Through Movement, there hasn't been any research yet on the efficacy of adding Kinesio Taping ® to standard physical therapy treatment. As indicated in the review, the goal of our study is to determine if Kinesio Tex Tape ® is a beneficial addition to a traditional HEP consisting of postural education and therapeutic exercises.

METHODS

Sample

A convenience sample from students, faculty, and staff at Andrews University in Berrien Springs, Michigan was used for this study. In order to participate in this study, volunteers were required to be eighteen years old or older and demonstrate FHRSP, defined by Kendall et al as a deviation of the external auditory meatus and acromion process from a plumb line. [1]

Subjects were screened for exclusion criteria using a health questionnaire they were required to complete (Appendix A). They were not allowed to participate if they had a past medical history of serious cervical, shoulder, or thoracic pathology that would prevent them from participating in the HEP, acute pain in any of those areas, or cardiovascular problems that contraindicated exercise. In addition, all volunteers received a small Kinesio Tex Gold® application to monitor for 24 hours for signs of sensitivity to the tape adhesive. Those volunteers who experienced a bad reaction to the tape were excluded from the study. Volunteers who were participating in a personal exercise program were asked continue their program without making any changes for the duration of the study.

Procedure

At the first appointment, the purpose of the study and the expectations for all volunteers was explained. All volunteers were required to complete a health questionnaire, give informed

consent (Appendix B), and were given the opportunity to ask the investigators any questions they had regarding the study and their participation. Volunteers who did not report any exclusionary criteria were accepted as subjects in the study.

They were then given a piece of Kinesio Tex Gold® to apply to their upper trapezius region. They were instructed to leave it there for at least 24 hours and return the following day to have the area checked for any signs of a sensitivity reaction. If they notice any redness, rash, itching, or other signs of a skin reaction before returning, they were instructed to remove the Kinesio Tex Tape® immediately and wash the area with soap and water. While no participants experienced any irritation during the twenty-four hour trial period, one subject did redness and itching under the tape application that was severe enough to cause them to remove themselves from the study. Five other subjects chose to remain in the study with less severe symptoms including redness, itching, and general discomfort.

The volunteers who still qualified for the study were given a full postural assessment, including measurement of deviation from "ideal posture" using a postural graph and head position using the Cervical Range of Motion instrument (CROM). All measurements were taken by the same investigator to improve their reliability. Males were asked to remove their shirts and females were asked to wear a sports bra or tank top to expose their neck, upper back, and shoulders.

The amount of FHRSP the subject demonstrated was measured using a postural graph, with the center line passing through a line estimating the bodies of the mid-lumbar vertebrae. The subject sat on a backless stool with their feet flat on the floor and was instructed to sit comfortably as they normally would at home and watch TV to ensure they were in their relaxed, normal posture. The midpoint of the acromion process was marked with a pen. Any deviation of

the right external auditory meatus from the center line was marked on the chart and measured in centimeters (Figure 1).

Forward head posture was also assessed with the CROM instrument, while the subject continued to sit on the stool and watch TV. The subject was then asked to put on the CROM instrument like a pair of glasses and the investigator lined it up with the nose and ears, making sure the side inclinometer read zero. The forward head measurement attachment was placed on the C7 spinous process and the level on the top was used to ensure it was vertical (Figure 2). The amount of forward head posture was recorded in centimeters.

The amount of rounded shoulder posture was also recorded using the postural graph, as well as a Baylor Square or T-bar. The postural graph measurement was taken concurrently with the forward head posture measurement, and consisted of measuring the distance from the mark on the shoulder to the center line in centimeters (Figure 1). The T-bar was aligned with the base of both the scapular spines and the distance to the midpoint of the acromion was measured in centimeters (Figure 3). Both measurements were taken bilaterally.

Subjects were given instructions and demonstrations of how to correctly perform each of the exercises in their HEP. They were required to demonstrate each one to the investigator to ensure they were performing it correctly. All subjects received hand-outs of the HEP, including pictures and written instructions for each activity. The HEP was to be done five days per week and recorded in an exercise log to improve compliance.

Figure 1. Postural graph measurement of forward head and rounded shoulders

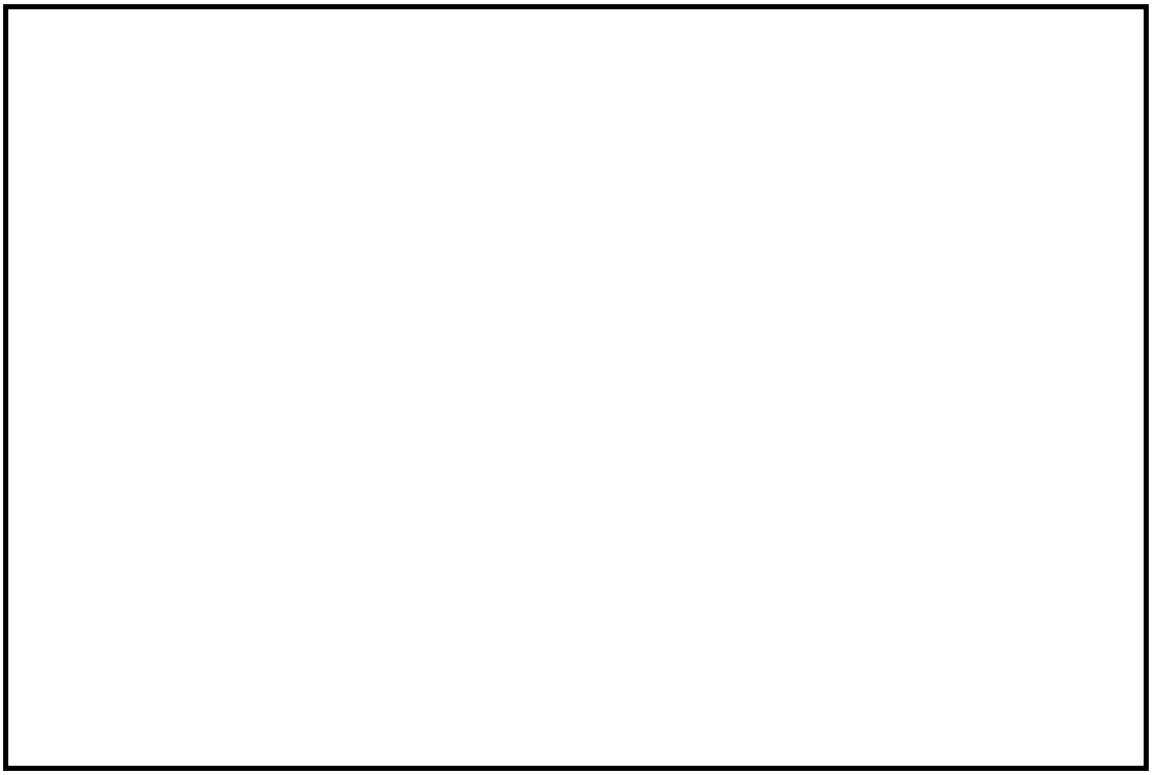


Figure 2. Measuring forward head posture with the CROM instrument

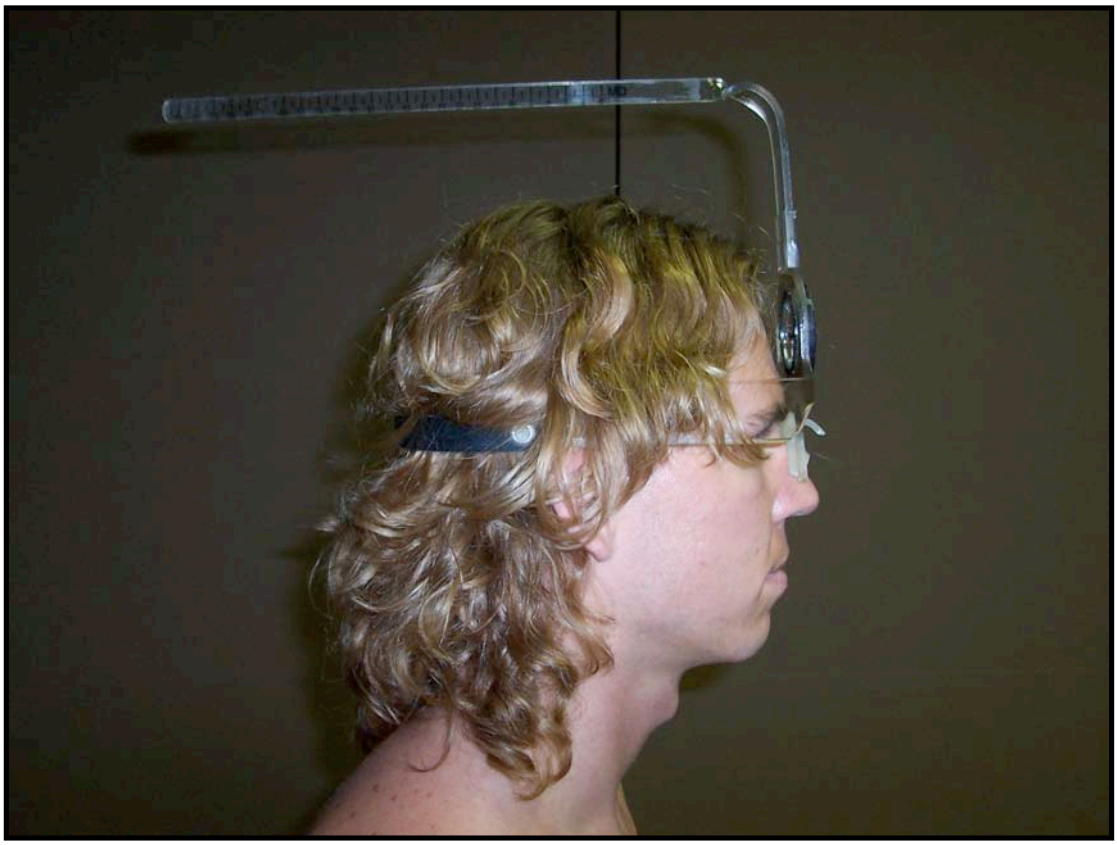
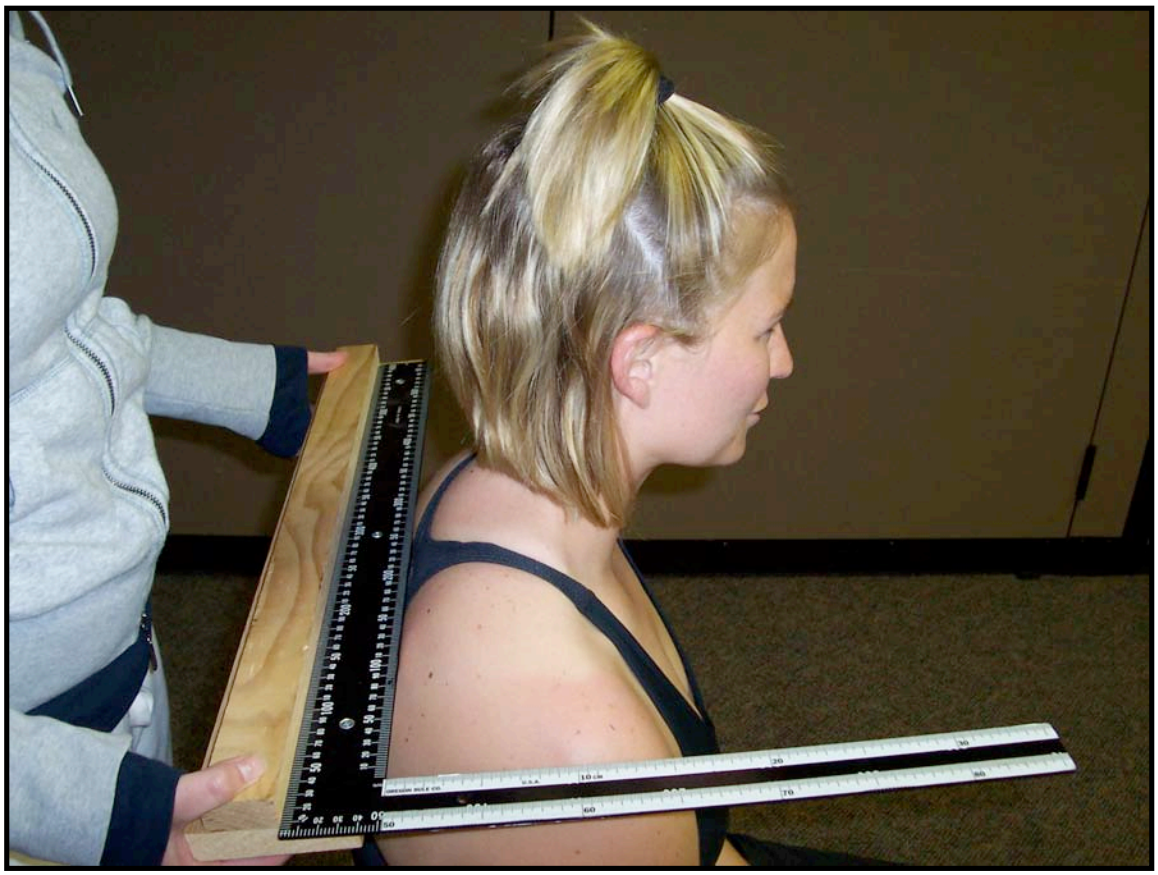


Figure 3. Measuring rounded shoulders with a T-bar



The HEP consisted of seven exercises (Appendix C). To perform the levator scapulae stretch (exercise #1), subjects were seated with one arm behind their back to stabilize the scapula. They side bent and rotated their neck to the contralateral side, producing a stretch in the

levator scapulae on the side of the stabilized scapula. For the upper trapezius stretch (exercise #2), the subject sat with one arm behind their back as in the first exercise. Then they laterally flexed their neck to the opposite side, producing a stretch in the upper trapezius. The pectoralis stretch (exercise #3) was done with the subject standing in a corner. Placing one hand on each wall with the elbows at shoulder level and one foot in front of the other, they leaned into the wall until they felt a stretch in their chest. For all stretches (exercises #1, 2, and 3) subjects were instructed to hold for thirty seconds and do two repetitions.

The second half of the HEP consisted of strengthening exercises. To strengthen the deep cervical flexors (exercise #4), subjects were instructed to lie supine and tuck their chin toward their Adam's apple and lift their head off the floor and hold the position for five seconds. In the lower trapezius exercise (exercise #5), subjects were prone with their arms overhead and dangling off the table, bed, etc. Keeping their thumbs up, they flexed their shoulders so their arms were at the level of their head and then lowered them back down to the resting position. The middle trapezius exercise (exercise #6) was a seated row. The final exercise was a standard serratus anterior push-up (exercise #7). For all strengthening exercises (#4-7), subjects were asked to do two sets of fifteen repetitions. If the exercises were too easy, subjects were given the appropriate level of Theraband to add sufficient resistance. Subjects were instructed to do each exercise slowly and rest between sets.

Then the subjects were randomly assigned by block to one of three treatment groups by pulling their names out of a hat. All subjects were required to complete the HEP. Those placed in Group 1 received a Kinesio Tex Gold® application designed to facilitate a more upright posture of the neck, shoulders, and upper back. This was actually a combination of two Kinesio Taping®

methods, one for forward head and the other for rounded shoulders. This method was selected and taught to the investigator by a certified Kinesio Taping® instructor (Figure 4).

Subjects in Group 2 were given a placebo Kinesio Taping® method. This application consisted of a strip of Kinesio Tex Gold® applied across the back from acromion to acromion and another piece applied from just below the hairline down the spine to the interscapular area to make it look similar to the Group 1 method underneath their clothes (Figure 5). The hope was to prevent subjects from knowing which group they were in. Both Groups 1 and 2 were required to set-up appointments to meet with the investigator once per week to re-apply the Kinesio Tex Tape®. After four days they were allowed to remove the Kinesio Tex Tape® themselves. If it fell off prematurely or became uncomfortable, they were asked to call the investigator and come in earlier to have the Kinesio Tex Tape® re-applied or to determine whether the discomfort necessitated their removal from the study. Only one subject chose to discontinue their participation in this study due to discomfort.

The subjects assigned to Group 3 received no tape application, and were therefore not required to meet with the investigator again until the end of the four week period. After four weeks, all subjects returned to the investigator for post-testing of FHRSP using the same assessment tools from the pre-testing appointment.

Figure 4. Kinesio Tex Tape® application

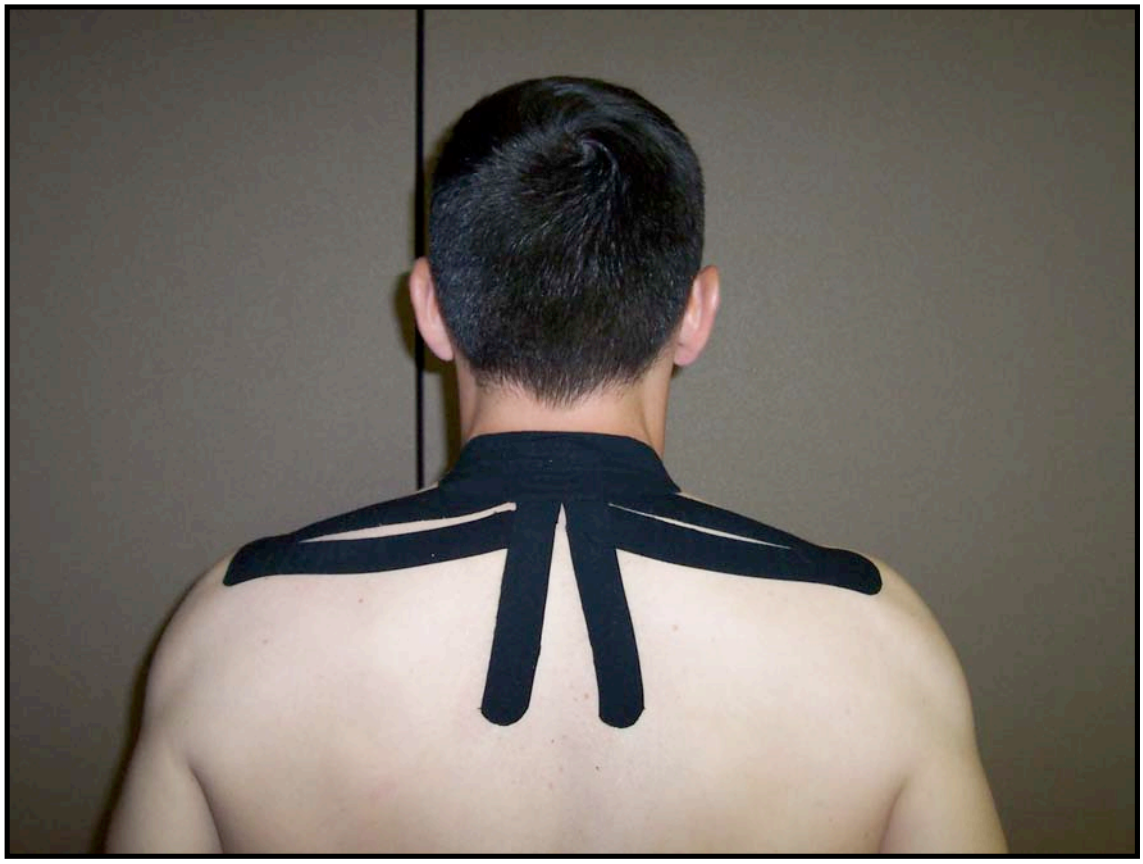


Figure 5. Placebo tape application

Data Analysis

The data was analyzed using the Statistical Package for Social Sciences (Version 17.0) software. To determine if there was a significant difference between the three intervention groups from pre-test to post-test for any of the independent variables, a repeated measures

analysis of variance (ANOVA) was used. The criterion α was set at .05. The dependent variables were the amount of forward head posture using a postural graph, forward head posture using the CROM instrument, rounded shoulders using a postural graph, and the amount of rounded shoulders using the T-bar.

RESULTS

Prior to the study, each assessment tool was tested on five subjects on two consecutive days to determine intratester reliability. The CROM showed excellent reliability (ICC = .915, p =.005), the forward head measurement on the postural graph showed poor reliability (ICC = .606, p =.101), and the rounded shoulders measurement on the postural graph showed good reliability (ICC = .896, p =.008). The T-bar showed poor reliability on the right (ICC = .652, p= .080) and good on the left (ICC = .800, p = .028). Based on these results, adjustments in test protocol were made for the postural graph and the T-bar to improve reliability.

Twenty-one subjects participated in this study, including thirteen females and eight males with a mean age of 26.3 years (SD ± 7.1). Eight subjects were assigned to the Kinesio Taping® group, eight to the placebo taping group, and five to the control group. One-way ANOVAs showed there were no significant pre-test differences between the groups for forward head or rounded shoulders as measured by the CROM instrument, postural graph, and T-bar. The mean initial measurement of rounded shoulders using the postural graph was 7.9 cm ± 3.1 cm for all twenty-one subjects on the right shoulder and 7.7 cm ± 2.7 cm on the left shoulder. The T-bar measurements showed a mean rounded shoulder of 10.6 cm ± 1.2 cm on the right and 10.4 cm ± 1.1 cm on the left. There was no difference from side to side. The mean amount of forward head posture at initial testing overall was 16.3 cm ± 1.4 cm with the CROM instrument, while the postural graph showed it to be 8.5 cm ± 2.9 cm. For final assessment and values by group, refer to Tables 1, 2, and 3.

Repeated measures ANOVAs indicated there was not a statistically significant difference between the three treatment groups for forward head as measured by the CROM instrument or the postural graph. While there was not a significant difference in the overall change in rounded shoulders on the right or left when measured with the postural graph, there was a difference in

the rate of change, with the Kinesio Taping® group (1) showing more rapid improvement as compared to the placebo group, which showed no change, and the exercise only group which actually exhibited slightly poorer posture. However, there was a statistically significant difference from pre-test to post-test for rounded shoulders using the T-bar on the right ($F = 22.1$, hypothesis df = 1.00, error df = 18.00, $\alpha < .001$) and on the left ($F = 12.2$, hypothesis df = 1.00, error df = 18.00, $\alpha = .003$), for all groups (Figures 7 and 8, respectively). There was not a statistically significant difference in bilateral T-bar measurements between the groups.

Table 1. Descriptive statistics of cervical range of motion (CROM) and forward head position (FH), including mean, standard deviation (SD), minimum (Min) and maximum (Max) by group.

Group		Initial CROM	Final CROM	Initial FH	Final FH
Kinesio Taping (n = 8)	Mean	16.80	16.19	8.65	8.11
	SD	1.58	.84	3.162	.917
	Min	15.00	15.00	4.50	6.50
	Max	19.50	17.50	12.60	9.40

Placebo Taping (n = 8)	Mean	16.31	16.13	9.63	9.88
	SD	1.36	.99	2.29	2.41
	Min	13.50	15.00	4.60	7.00
	Max	18.00	18.00	11.40	14.20
Exercise Only (n = 5)	Mean	15.60	15.70	6.42	7.86
	SD	.962	.27	2.70	2.38
	Min	14.00	15.50	2.90	5.50
	Max	16.50	16.00	10.40	11.40
Total (n = 21)	Mean	16.31	16.05	8.49	8.72
	SD	1.38	.81	2.90	2.08
	Min	13.50	15.00	2.90	5.50
	Max	19.50	18.00	12.60	14.20

Table 2. Descriptive statistics of T-bar measurements of rounded shoulders (TBar), including mean, standard deviation (SD), minimum (Min), and maximum (Max) by group.

Group		Initial Right TBar	Final Right TBar	Initial Left TBar	Final Left TBar
Kineiso Taping (n = 8)	Mean	10.28	9.21	10.18	9.24
	SD	1.49	.78	1.44	.90
	Min	7.90	7.70	8.40	7.40
	Max	12.10	10.00	12.90	10.40
Placebo	Mean	11.28	9.61	11.08	9.25

	SD	.80	1.50	.48	1.86
	Min	10.20	6.50	10.50	4.90
	Max	12.40	11.20	12.00	10.90
Exercise Only (n = 5)	Mean	10.10	9.60	9.78	9.38
	SD	.72	1.22	.80	.48
	Min	9.30	7.60	8.70	8.60
	Max	10.90	10.90	10.60	9.90
Total (n = 5)	Mean	10.61	9.46	10.42	9.28
	SD	1.18	1.16	1.11	1.24
	Min	7.90	6.50	8.40	4.90
	Max	12.40	11.20	12.90	10.90

Table 3. Descriptive statistics of postural graph measurements of rounded shoulders (RS), including mean, standard deviation (SD), minimum (Min), and maximum (Max) by group.

Group		Initial Right RS	Final Right RS	Initial Left RS	Final Left RS
Kineiso Taping (n = 8)	Mean	7.49	6.98	7.80	6.10
	SD	3.25	1.13	3.44	1.83
	Min	4.50	4.90	4.20	4.10
	Max	12.60	8.80	13.20	9.70
Placebo Taping	Mean	9.34	9.35	8.68	8.71
	SD	2.18	2.44	2.20	2.38

	Min	5.10	5.10	4.70	5.60
	Max	12.30	13.60	11.20	11.60
Exercies Only (n = 5)	Mean	6.34	7.34	6.04	6.30
	SD	3.53	2.64	1.49	1.56
	Min	3.10	4.20	4.40	4.70
	Max	12.20	11.20	8.40	8.50
Total (n = 21)	Mean	7.92	7.97	7.71	7.14
	SD	3.06	2.28	2.71	2.29
	Min	3.10	4.20	4.20	4.10
	Max	12.60	13.60	13.20	11.60

Figure 6. Amount of right rounded shoulders per group as measured by the T-bar.

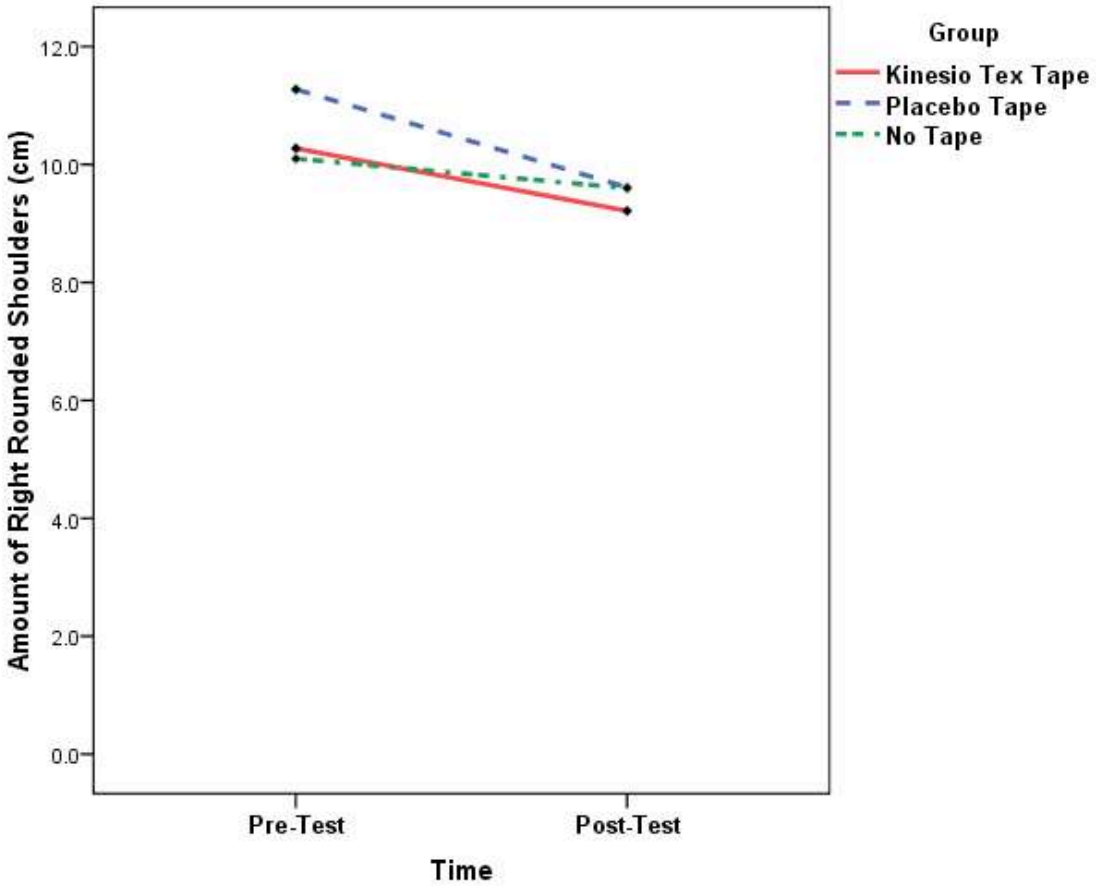


Figure 7. Amount of left rounded shoulders per group as measured by the T-bar.

DISCUSSION

While the only statistically significant difference between the groups at post-test was found in the amount of rounded shoulders as measured with the T-bar, it must also be noted that this measurement itself was found to have poor. Thus, the discussion of change must include that there is an increased chance of error due to the poor reliability of the test. Also, the T-bar measurements did not show a statistically significant difference between the groups, indicating that while all groups were showing improvement, there was not one group that demonstrated greater improvement than the others. All treatments were equally effective in reducing rounded shoulder posture. This was surprising as Kahanov[4] theorizes that proper Kinesio Tex Tape® applications can facilitate proper alignment.

The postural graph had poor reliability for assessing forward head posture and good reliability for assessing rounded shoulders. The reliability of these measurements may have been affected by the researcher's inexperience using these pieces of equipment as well as the fluctuating nature of resting posture. While the subjects were sitting on the same stool, with their feet flat on the ground, and the postural graph and T-bar lined up the same way each time, it was still difficult to ensure each participant was assuming the same posture each time. Even when

asked to sit still while taking the measurements, many subjects were making slight postural adjustments. Despite the low results of the reliability testing, these measurements were still used to assess FHRSP since the sample size for the reliability testing was small, although additional measures to improve the accuracy of the measurement.

While there were no differences found for the left side for shoulder posture from pre-test to post-test as measured by the postural graph, there was a difference in the rate of change (though not significant). This suggests that there even though there wasn't a significant change from pre-test to post-test, the Kinesio Taping® group was showing a more rapid improvement than the placebo taping and control groups. It wasn't enough to be considered statistically significant in this study, but with a larger sample size or longer study duration, this trend might continue (See Figure 6).

Since therapeutic exercise has been shown to improve posture and all three groups participated in a home exercise program, we anticipated a difference from pre-test to post-test in addition to a difference between the three treatment groups. Fall et al[11] found an improvement in FHRSP following a therapeutic exercise program targeting only the craniocervical flexors. There were several important differences with this study, including its larger sample size (n = 58), longer duration of six weeks, and the subjects they used had a history of chronic neck pain.

Similarly, a study done by Pesco et al[7] found that subjects with a history of neck and shoulder pain and stiffness saw a significant decrease in their symptoms following an intervention program consisting of postural education and active exercises. They used more subjective outcome measures in this study, including a numeric pain scale and a survey regarding their perceived level of pain and stiffness.

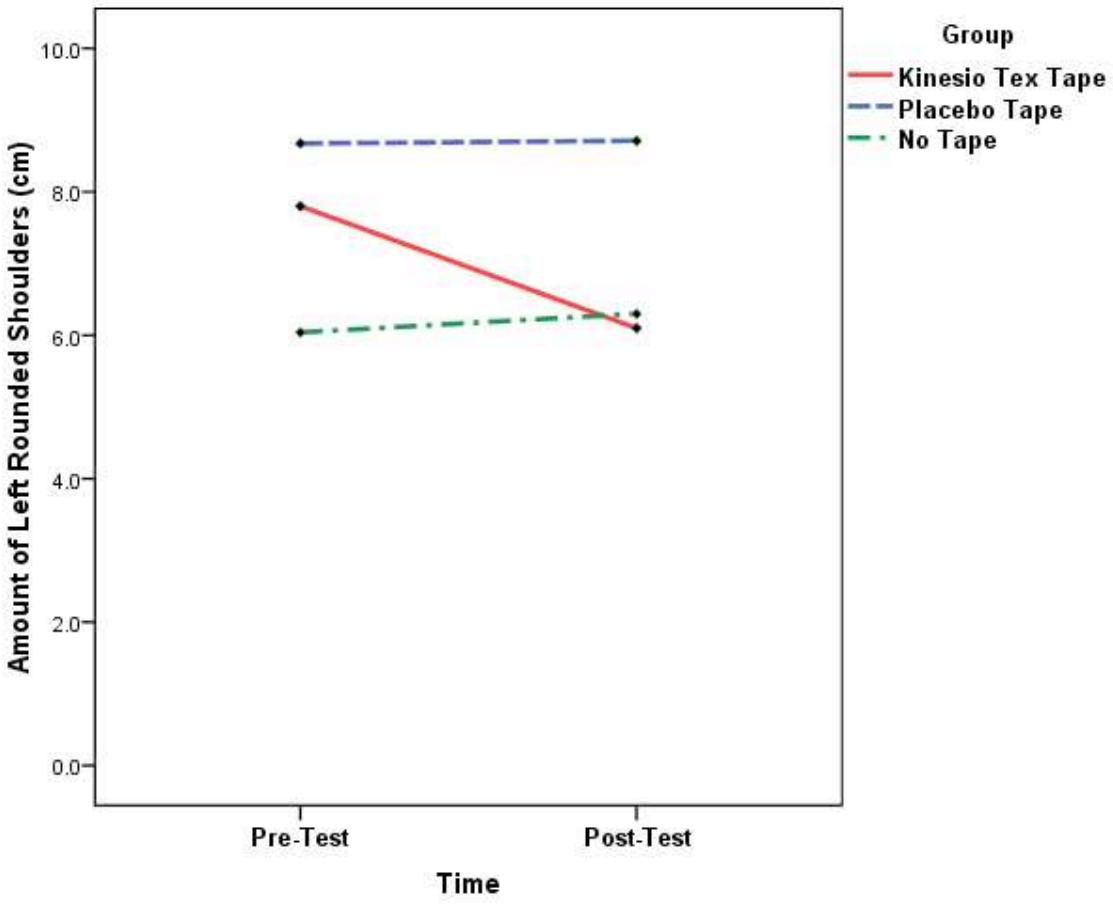


Figure 8. Amount of left rounded shoulders per group as measured by the postural graph.

Other factors which could have affected these results and relate to the usefulness of the tape in the clinic, include the subjects' reactions to the Kinesio Tex Tape®. This study was conducted in the summer months, which presented a problem to anyone wishing to wear bathing suits or tank tops for cosmetic reasons, and they were warned to avoid prolonged exposure to the sun due to the fact that the adhesive is heat-activated. Many potential subjects were deterred by fears that it would be uncomfortable, which in many cases proved to be true. While most subjects complained of minor itching, redness, or general discomfort, several subjects experienced significant discomfort and itching which resulted in one subject being removed from the study. There was also difficulty in some cases getting the Kinesio Tex Tape® to stick, even with proper skin preparation with alcohol swabs. A spray adhesive was added in several subjects who demonstrated more serious problems keeping the tape on, and there were several instances in which the Kinesio Tex Tape® needed to be re-applied altogether before the four day period expired.

Based on these findings, a suggestion for future studies is that some modifications in study method be made. A longer study duration and larger sample size would be helpful, as well as using subjects with a history of posture-related impairments such as headaches and neck and shoulder pain and stiffness. More experience in Kinesio Tex Tape® application and more reliable measurement techniques would improve the reliability of the study overall. In addition, adding a subjective assessment of pain, headaches, and stiffness would give us more insight into all the potential effects of Kinesio Tex Tape®.

CONCLUSION

Despite its growing clinical use, there is limited research supporting the use of Kinesio Taping® for any purpose, anywhere in the body. The purpose of this study was to determine its effects as part of a therapeutic exercise program to decrease FHRSP, which is becoming increasingly common in our society and has been shown to contribute to multiple cervical, thoracic, and shoulder pathologies.

A convenience sample of 21 volunteers who demonstrated FHRSP was divided into three treatment groups. Group 1 received a combination of two Kinesio Taping® methods, one for forward head and the other for rounded shoulders. Group 2 received a non-therapeutic taping method and group 3 was a control and did not receive a tape application. All three groups were assessed pre-intervention for FHRSP using a postural graph, CROM instrument, and T-bar and given a home exercise program designed to stretch or strengthen key postural muscles. Subjects in groups 1 and 2 were required to meet with the researcher every week to receive their new Kinesio Tex Tape® application which was to be worn for four days. After four weeks, subjects from all three groups returned for post-intervention assessment.

The only significant difference from pre-test to post-test was in the T-bar measurements of rounded shoulders. Thus, this study does not support our hypothesis that the use of Kinesio Tex Tape® is effective in reducing poor posture over a short, four week intervention period. Exercise was just as effective as exercise combined with taping in the treatment of posture.

REFERENCES

1. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. *Muscles: Testing and Function with Posture and Pain*. 5th ed. Baltimore, MD: Williams & Wilkins; 2005: 59-61.

2. McHugh ML, Schaller P. Ergonomic nursing workstation design to prevent cumulative trauma disorders. *Comp in Nurs*. 1997; 15 (5): 245-252

3. Fu TC, Wong A, Pei YC, Wu KP, Chou SW, Lin YC. Effect of Kinesio taping on muscle strength in athletes – A pilot study. *J Science Med Rehab*. 2008; 11,198-201.

4. Kahanov L. Kineso Taping, part 1: An overview of its use in athletes. *ATT*. 2007; 12(3):17-18.

5. Womersley L, May S. Sitting posture of subjects with postural backache. *J Man Phys Ther*. 2006; 29(3): 213-218.

6. Griegel-Morris P, Larson K, Mueller-Klaus K, Oatis CA. Incidence of common postural abnormalities in the cervical, shoulder, and thoracic regions and their association with pain in two age groups of healthy subjects. *Phys Ther*. 1992; 72(6): 425-431.

7. Pesco MS, Chosa E, Tajima N. Comparative study of hands-on therapy with active exercises vs education with active exercises for the management of upper back pain. *J Man Physio Ther*. 2006; 29(3): 228-235.

8. Borstad, JD. Resting position variables at the shoulder: Evidence to support a posture-impairment association. *Phys Ther*. 2006; 86(4): 549-557.

9. Magee DJ, Waldman M, Morrissey D. *Orthopedic Physical Assessment*. 4th ed. Philadeplphia, PA: Elsevier Sciences; 2006: 131.

10. Bialocerkowski AE, Grimmer KA, Nyland LJ. Prevalence of and risk factors associated with neck problems in undergraduate physiotherapy students. *Physiother Can*. 2005; 57(4):293-302.

11. Falla D, Jull G, Russell T, Vicenzino B, Hodges P. Effect of neck exercise on sitting posture in patients with chronic neck pain. *Phys Ther*. 2007; 87(4): 408-416.

12. Kebaetse M, McClure P, Pratt NA. Thoracic position effect on shoulder range of motion, strength, and three-dimensional scapular kinematics. *Arch Phys Med Rehabil.* 1999; 80(8): 945-950.

13. Burn S, Eytcheson K. *The effects of therapeutic rollers on forward head posture and rounded shoulders*. Berrien Springs, MI: Andrews University; 2001. Thesis.

14. Jain S, Janssen K, DeCelle S. Alexander technique and Feldenkrais method: A critical overview. *Phys Med Rehabil Clin N Am*. 2004; 15: 811-825.

15. Ruth S, Kegerreis S. Facilitating cervical flexion using a Feldenkrais method: Awareness through movement. *J Orthop Sports Phys Ther*. 1992; 16(1): 25-29.

16. Schatz MP. Posture-perfect shoulder and neck exercises. *Phys Sports Med*. 1994; 22(8): 69-70.

17. Roddey TS, Olson SL, Grant SE. The effect of pectoralis muscle stretching on the resting position of the scapula in persons with varying degrees of forward head/rounded shoulder posture. *J Man Manip Ther*. 2002; 10(3): 124-128.

18. Benedict BS, Brigner JL. *The efficacy of stretching and strengthening exercises for correcting forward shoulder posture*. Berrien Springs, MI: Andrews University, 2001. Thesis.

19. Bandy WD, Irion JM, Briggler M. The effect of time and frequency of static stretching on flexibility of the hamstring muscles. *Phys Ther*. 1997; 77(10): 1090-1096.

20. Capuano-Pucci D, Rheault W, Aukai J, Bracke M, Day R, Pastrick M. Intratester and Intertester Reliability of the Cervical Range of Motion Device. *Arch Phys Med Rehabil*. 1991; 72:338-340.

21. Peterson DE, Blankenship KR, Robb JB et al. Investigation of the validity and reliability of four objective techniques for measuring forward shoulder posture. *JOSPT*. 1997; 25: 34-42.

22. Slupik A, Dwornik M, Bialoszewski D, Zych E. Effect of Kinesio Taping on bioelectrical activity of vastus medialis muscle. Preliminary report. *Trauma Ortho Rehab*. 2007; 6(6): 644-651.

23. Murray H. Effects of Kinesio Taping® on muscle strength after ACL repair. *J Orthop Sports Phys Ther*. 2000; 30(1).

24. Fu T, Wong A, Pei Y, Wu K, Chou S, Lin Y. Effect of Kinesio taping on muscle strength in athletes – a pilot study. *J Sports Sci Med. 2008*; 11, 198-201.

25. Nosaka K. The effect of Kinesio Taping® on muscular micro-damage following eccentric exercises. Presented at the 15th Annual Kinesio Taping International Symposium Review; 1999; Tokyo, Japan.

26. Murray H. The effects of Kinesio Taping® on proprioception in the ankle and in the knee. *J Orthop Sports Phys Ther*. 2001; 31(1).

27. Thelen MD, Dauber JA, Stoneman PD. The clinical efficacy of Kinesio Tape for shoulder pain: a randomized, double-blinded, clinical trial. *J Orthop Sports Phys Ther*. 2008; 38 (7): 389-394.

28. Brandon R, Paradiso L. The use of Kinesio® Tape in patients diagnosed with patellofemoral pain. Kinesio Taping Association. 2005. Available at: www.kinesiotaping.com/patellofemoral-pain-kt.php. Accessed January 12, 2009.

APPENDIX A

ANDREWS UNIVRESITY

Department of Physical Therapy

Health Questionnaire

Last Name: _____ First Name:_____
Age:_____ Gender: M F Phone:_____
Address_____ City: _____
State: _____ Zip Code: _____

Medical History Year

Sensitive Skin	Y / N	_____
Cervical Pain	Y / N	_____
Shoulder Pain	Y / N	_____
Headaches	Y / N	_____
Hypertension	Y / N	_____
Diabetes/Hypoglycemia	Y / N	_____
Heart Palpitations	Y / N	_____

Do you have any other medical problems that may prevent you from participating in an exerciseprogram:_____
_____

Current Medications (if applicable):
_____
_____

I affirm that the information above is true to the best of my knowledge and that I am not withholding any pertinent medical information that may be harmful to myself or to the researchers by participating in this study.

_____
Signature of Participant Date

APPENDIX B
ANDREWS UNIVERSITY
Department of Physical Therapy
Informed Consent Form

TITLE
The Efficacy of Kinesio Tape in Improving Forward Head Posture
INVESTIGATORS

Diana Lewis, Graduate Student in Physical Therapy; Lynn Millar, PhD, PT, Research Committee Chair

PURPOSE

Forward head posture is becoming increasingly common as American lifestyles become increasingly conducive to sitting for prolonged periods of time. The ramifications of forward head posture can be felt throughout the entire upper body. The goal of this study is to examine the effects of Kinesio Tape in conjunction with other common treatments in directly decreasing the severity of forward head posture and indirectly decreasing problems associated with it.

INCLUSION CRITERIA

In order to participate in this study, I understand that it is my responsibility to fill out the health questionnaire honestly and report any anticipated problems to the investigators. I understand that I cannot participate if I have any known barriers to exercise according to my physician or allergies to the adhesive being used.

PROCEDURE

I understand that I will have to attend two assessments that will last 30-60 minutes, at which the following measurements will be taken: amount of forward head, and amount of forward shoulders. I will be randomly assigned to one of three groups, and if I am assigned to a group that receives Kinesio Tape applications, it may or may not be a placebo, and I will be required to allow the investigators to apply Kinesio Tape to my upper back and neck, which I will wear continuously for four days. I will be expected to make appointments with the investigators to have my tape re-applied once per week and participate in a home exercise program five days per week for four weeks. I understand that I am not to remove the tape myself between appointments unless it causes discomfort or irritates my skin.

RISKS AND DISCOMFORTS

By participating in this study, I may experience some skin irritation including redness, rash, or itching. These should only be mild if carefully monitored and should be caught during the pre-participation tape trial. I should avoid direct, prolonged exposure to the sun and other sources of heat with the tape on. Should these symptoms develop, it is my right and responsibility to remove the tape, contact the investigators, and remove myself from the study if necessary. I may also experience neck, upper back, or shoulder pain as a result of the exercise program. While minor muscle aches are a normal part of a new exercise program, more serious pain such as that occurring in the joints or that rates greater than a 5 on a scale of 0-10 (10 being worst pain imaginable and 0 being no pain at all) should be reported to the investigators immediately and I may have to remove myself from the study. I also give consent to have my picture taken by the examiners and understand these photographs may be used in the presentation or publication of this study.

BENEFITS/RESULTS

I understand that my participation in this study may or may not yield any direct benefits for me. My information will be used in a Doctoral Thesis, be presented or published, and may aid clinicians in using the most effective treatments to correct forward head posture.

VOLUNTARY PARTICIPATION

I understand that my participation in this study is strictly voluntary and I will not receive any form of compensation for it. I also acknowledge that I am free to leave the study at any time without penalty.

Participant's Initials _____

CONFIDENTIALITY

I understand that all information collected during this study will be kept confidential by the investigators.

REQUEST FOR MORE INFORMATION

The investigators have explained the purpose and procedures of this study to me and gave me the opportunity to ask questions. If any questions arise later during the study, I can contact Diana Lewis at 517-403-8068 or the research committee chair Lynn Millar at 269-471-3588. Their contact address is Andrews University Physical Therapy Department, Andrews University, Berrien Springs, MI 49102.

INJURY STATEMENT

In the unlikely event of injury resulting from this research, Andrews University is not able to offer financial compensation nor to absorb the costs of medical treatment. However, assistance will be provided to research subjects in obtaining emergency treatment and professional services that are available to the community generally at nearby facilities. My signature below acknowledges my consent to voluntarily participate in this

research project. Such participation does not release the investigator(s), institution(s), sponsor(s) or granting agency(ies) from their professional and ethical responsibility to me.
I have explained the purpose, procedures, and possible risks and benefits of this research study to the best of my ability to _____.

_____ _____
Investigator Signature Date

I confirm that _____ has explained the purpose, procedures, risks, and benefits of this research study. I have read and understand this consent form and had all my questions answered satisfactorily. I agree to give my consent to participate as a subject in this study.

_____ _____
Participant Signature Date

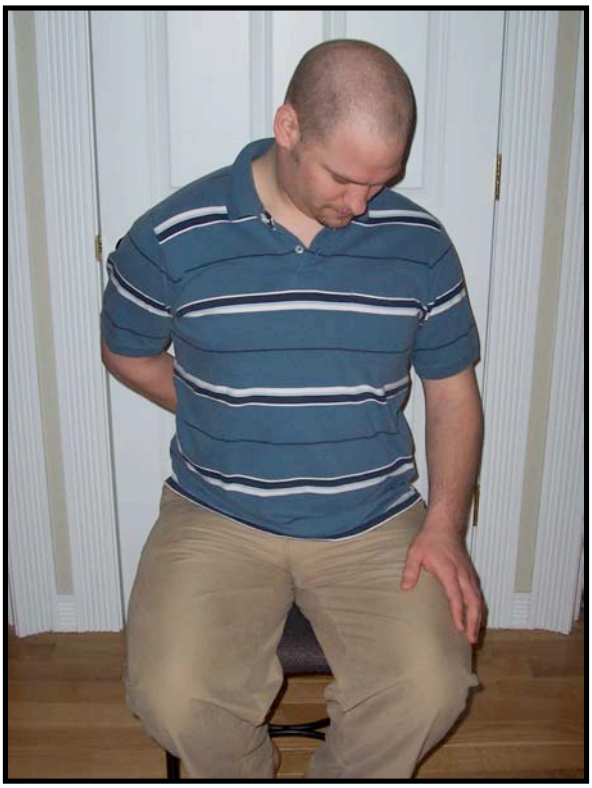
_____ _____
Witness Signature Date

Participant's Initials_____

APPENDIX C

Exercise #1 – While seated, place your left arm behind your back, then tilt your head forward and toward the right knee. You should

feel a comfortable stretch in the back of your neck on the left side. Repeat on other side. Hold each for thirty seconds and do two repetitions five days per week.



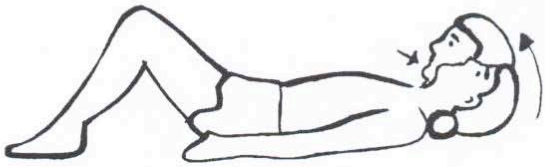
Exercise #2 – While seated, place your left arm behind your back, then tilt your head toward the right shoulder until you feel a comfortable stretch on the left side of your neck. Repeat on other side. Hold each for thirty seconds and do two repetitions five days per week.

 800.653.2510 or 413.596-5041

#3

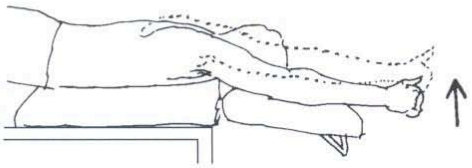
Pectoralis Corner Stretch, 2 sets
Stand facing a corner, with your hands on adjacent walls at shoulder level, elbows slightly bent. Stand with your feet in a lunge position (one leg in front of the other). Bend your front knee, pressing your upper body toward the corner. Hold for 30 seconds. Return to the starting position and relax. Remember to keep your low back relaxed and your chin tucked. Alternate the forward leg each time. Do 2 sets of ___. Do exercise 5 times/week.

#4



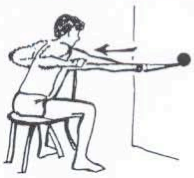
Stage II Short Neck Flexors, 2 sets of 15
Lie on your back and place a rolled towel behind your neck. Tuck chin in and lift up your head no more than one inch from the floor. Hold 5 seconds. As you get less fatigued, take the pillow away. Do 2 sets of 15. Do exercise 5 times/week.

#5



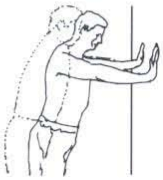
Lower Trapezius, 2 sets of 15
Lying on your stomach with arm overhead, elbow straight with thumb up, raise arm up from floor/bed. Hold for ___ seconds. Relax. Advanced exercise: Hold ___ pound(s) of weight in your hand. Do 2 sets of 15. Do exercise 5 times/week.

#6



Rowing Movement with Elastic, 2 sets of 15
Loop elastic band around railing pole. Hold each extremity as shown in drawing. Keep elbows flexed and squeeze shoulder blades together. Keep chin in throughout exercise. Hold for ___ seconds. Do 2 sets of 15. Do exercise 5 times/week.

#7



Serratus Anterior, Standing, 2 sets of 15
While standing, face a corner of the room and place your hands at shoulder level on either side of the wall approximately shoulder width apart. Perform standing push-up. Do 2 sets of 15. Do exercise 5 times/week.

General Instructions
Discontinue exercise program if you experience any discomfort or pain.

Please check when you have completed your exercises:

2/20	2/21	2/22	2/23	2/24	2/25	2/26