

Effectiveness of Cross Taping as a Therapy for Delayed Muscle Soreness

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Abstract: Background & purpose, Decrease muscle soreness by medical tape is supported by the literature. The purpose of this study was to assess the efficacy of the cross tapes in muscle soreness. Twenty normal subjects ranging in age from 18 to 55 with no history of previous skin allergy from any tape and do not have any upper body injuries participated. Subjects will perform the lowering phase of a bicep curl exercise using a dumbbell consisting of 3 sets 25 repetition, followed 90 seconds rest between each set. A grid shaped adhesive, a little larger than a stamp, called a cross tapes will be applied in the bicep of the dominant hand and the other hand as control for one week. The range of motion and pain for both arms will be measured before and after applied the tape. The study findings show that there were statically significant difference between the range of motion and the pain (pre, post) when the procedure is carried out over a period of two consecutive weeks (1 day per week) with large effect size (0.2) and strong power (0.96). However; there were no significant differences between the two groups (right, left arms) with medium effect size (0.1) and weak power (0.33). Therefore, this study suggest that cross tapes may reduce delayed onset of muscle soreness, however more research is needed. Future studies should include a larger number of subjects, more diverse cohort, an exercise that applies a greater intensity, and expands the time of research. Cross tape is an advisable method to decrease delayed onset of muscle soreness and improved functional performance.

Keywords: Muscle Soreness, Medical Tape, Improve Activity, Cross Tapes, Pain, Improve Athletic Performance, Physical Fitness

1. Introduction

The ability of an individual to move smoothly depends on his flexibility, an attribute that enhances both safety and optimal physical activities (Van der Wees, 2016). This ability to move freely and easily throughout full range of motion is important in daily exercises. However, for some reason this ability is hampered by muscle pain.

Muscle soreness is the big headache for the athletic or anyone start a new exercise. Medical taping especially Cross tapes claims to have positive effects on circulation, muscle function, and pain. Muscle soreness can be reduced by simple procedures like Cross tape. CT is kind of therapy which medical practitioners on many occasions use to treat different muscle pain on the thigh, lower part of the leg, the arms and wrists (Wade & Bernstein, 2017). According to the K-Taping academy, these tapes produce very good results in pain reduction when practitioners use them in combination with

K-training.

Delayed onset muscle soreness is a kind of muscle pain that occurs when unfamiliar movements such as violent and sudden physical activities of high intensity are performed. The most likely instances for DOMS to occur are when there is eccentric contraction of the muscles for example when unloading heavy objects and when going down the stairs (Fritz, 2013). The soreness takes place within 24 hours

disappears of exercise increasing within 48 to 72 hours and afterwards within five to seven days.

Many practitioners are embracing the use CT as it brings positive impact in balancing energy flow in the body. The fact that they are non- medicated make them suitable option for many people in treatment of muscular pain except in cases of open wounds, skin complications and skin sensitivity.

2. Review of the Literature

2.1. Need for Exercising

Exercises form an integral part of our life. Human beings should exercise daily during our daily activities, but the extent of the exercises differ between individuals.

People who tend to exercise more live a more healthy life and age slowly than those who exercise less (González-Iglesias, 2016). When people exercise after a prolonged period without exercise, they tend to develop muscle pains but this should not prevent us from exercising. It is therefore wise to find a remedy to overcome this problem of muscle pains, which the use of CT is set out to solve.

2.2. Living a Happy and Healthy Life

A happy and healthy life is what all strive to achieve. This cannot come to pass if bodies are in any pain or discomfort (González-Iglesias, 2016). It is therefore of utmost importance to keep the body free from the pain of any kind, and CT are aimed at helping this come to reality by helping to eliminate any kind of pain from the body.

2.3. Anatomical Composition of the Biceps Muscle

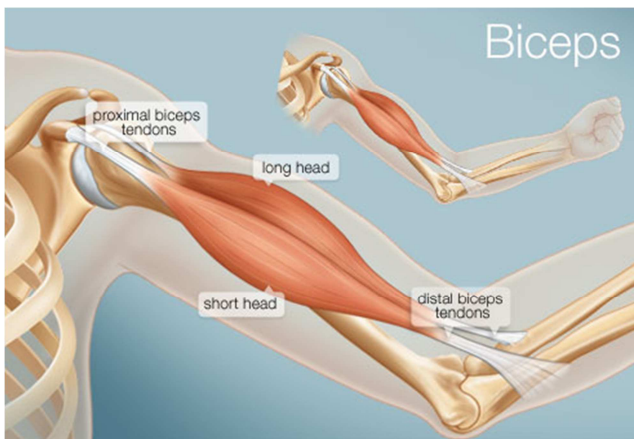


Figure 1. Biceps muscle.

This is a muscle on the front part of the upper arm. The biceps comprises of a short head and a long head, working as a single muscle. Tendons, which are tough connective tissues, attach the biceps to the arm bones. Distal biceps tendon attaches the biceps muscle to the forearm bones, radius and ulna. The biceps contracts pulling the forearm up and rotating it outwards. Biceps strain is caused by overstretching and tearing of tendons with swelling and pain as the symptoms.

2.3.1. Origin

The shoulder is a ball-and-socket joint made up of three bones: humerus (upper arm bone), (shoulder blade) scapula, and the collarbone (clavicle).

The head of the upper arm bone fits into a rounded socket in the shoulder blade. This socket is referred to as glenoid. The tissues are referred to as the rotator cuff. The tissues cover the head of the upper arm bone therefore attaching it to your

shoulder blade (Quilty, 2016). The biceps muscle consists of two tendons that attach it to the bones in the shoulder. The long head is attached to the top of the shoulder socket, the Supraglenoid tubercle of the scapula. The glenoid is lined with soft cartilage known as the labrum. This tissue assists the head of the upper arm fit into the shoulder socket. The short head of the biceps tendon attaches to a bump on the shoulder blade known as the coracoids process together with coracobrachialis.

2.3.2. Insertion and Innervation

“Both heads, after their separate origin, distally unite to form a common tendon inserting into the posterior rough part of the radial tuberosity of the radial bone. At its site of insertion, it gives off an extension called bicipital aponeurosis (Lacertus fibrosus). Biceps brachii is innervated by musculocutaneous nerve (MCN)” (Bagoji et al, 2014).

2.3.3. Movement

A combination of muscles and tendons keeps the arm centered in the shoulder socket. The biceps muscle is in the front side of the upper arm. It is used to bend the elbow (flexion) and rotate the arm (strong supinator when the forearm is flexed) as well as keeping the shoulder stable (Williams et al, 2015).

2.4. Delayed Onset of Muscle Soreness

Muscles experience soreness due to weight resistance, and not when the weight is lifted (Quilty, 2016). For instance, muscle soreness is not experienced when curling a dumbbell upwards; however, lowering the dumbbell forces the dumbbell to be stretched as it resists gravity and as such causes a micro trauma and muscle soreness (Keil, 2012).

This is to say that if only the positive phase of lifting was completed without any weight resistance on the way down, no muscle soreness would be experienced.

2.4.1. Types of Contractions

The muscles perform three different types of contractions being concentric, eccentric and isometric (Chen et al, 2013). Concentric contractions occur for example when lifting a weight up to the face, like above mentioned.

Eccentric contractions are experienced when bringing the weight down and are characterized by a lengthening in the muscle fibers and as such plays a role in muscle soreness (Dawood, 2016). An isometric contraction on the other hand occurs when one is holding an object in a fixed position. Eccentric contractions cause a lot of tension and allow one to lower much heavier weight than what one can lift. Additionally, skeletal muscle is resistant to lengthening by nature. Eccentric contractions when repeated as such induce muscle damage.

2.4.2. Mechanism and Recovery

Mechanism of delayed onset of muscle soreness is not described completely. DOMS is considered as type I muscular strain, which may result in debilitating pain that impedes mobility.

Numerous theories have been postulated to define the

mechanism of muscle soreness. However, all theories concede that eccentric action is the key stimulator of DOMS.

a. Mechanism I: Structural Damage- An augmentation is observed in the concentration of muscle enzymes in blood (2 to 10 folds increase depending on the degree of breakdown) following intense exercise indicate structural damage of muscle membrane. As a result the content of the ruptured muscle cells freely float between the normal muscle fibers. During muscle contraction, contractile proteins contact at Z-disks and transmit force during contraction, however, in eccentric exercise steaming of Z-disk occurs and thin and thick filaments of sarcomeres may get disrupted causing tenderness and debilitating pain or swelling. Probably, muscle damage precipitates its hypertrophy (Kenny et al., n.d.).

b. Mechanism II: Inflammatory Reaction- White blood cells respond to muscle damages as an acute inflammatory reaction, cellular components, especially mononucleotide cells released due to muscular tissue damage may act as attractants to stimulate the inflammation.

Also, neutrophils enter the injury site and release immunoregulatory cytokines. Probably, neutrophils release free radicals of oxygen, damaging cell membranes and this invasion is connected with pain. Macrophage clear the cellular debris by phagocytosis leading to regeneration of muscles (Kenny et al., n.d.).

c. Mechanism III: Other events- There are other postulated theories to understand the mechanism of DOMS encompassing- high tensions (due to eccentric exercise) cause structural damage; damage of cell membrane causing disruption of Ca^{++} homeostasis, consequently, necrosis occurs; accumulation of- intracellular contents as well as products of macrophage activity in the interstitium. Subsequently, in muscles, free nerve endings of sensory neurons (of Group IV) are stimulated causing responsiveness of DOMS (Armstrong, et al. 2014). DOMS occurs when weight is lowered, therefore lengthening of the muscle, micro trauma to muscle fibers occur, the body removes dead muscle fiber tissues and regenerates to allow resistance to further stress.

After the muscles experience soreness, they adapt rapidly to reduce the chances of further damage from the same exercise of heavy weight lifting. This is known as repeated-bout effect. This reduces soreness and swelling the next time heavy lifting or the same exercise is done. There is also reduced strength as well as reduced range of +33motion therefore much faster recovery.

2.5. Therapeutic Tapes

Therapeutic taping has found increasing acceptance among health care providers. TT was first introduced to Europe in 1999 and has roots in Japan (Esther, 2013). The TT has an effect on deactivating of the pain system. The signals of irritated noci-sensors passing throw the posterior horn to reach the cortex then the pain appear. Taping stimulates the thicker A-beta-skin nerves that makes the re-establishment of the functions and quickens the healing process (Williams et.al, 2015).

2.6. Kinesio Tape

Kinesio tape is an elastic strip made of cotton, which is applied in the human body with the help of adhesive. KT is used in the field of healthcare that is specifically designed to reduce muscular pain and inflammatory conditions associated with musculoskeletal injuries. Notably, KT is widely used to overcome physical disorders as well as in the treatment of injuries and muscular pains often experienced by athletes (Kinesio, 2013). The KT works on a specific mechanism towards reducing the effects of athletic injuries and stress on muscles.

Specifically mentioning, KT works on the mechanism of 'gate control theory' that is concerned with interrupting the pain receptors towards ensuring that the pain message is unable to reach the brain and the pain gets reduced. Another mechanism that can be highlighted with respect to working of KT is the concept of 'light modality' that is concerned with reducing muscular pain without obstructing movement of body parts. Notably, KT is designed in a manner that facilitates easy movement of body parts, apart from enabling natural healing owing to its lightweight application (Kinesiology Tape Info Center, 2011).

The KT can impose a significant impact on reducing muscle soreness among people suffering from muscular pain. Considering its elastic nature, the KT facilitates blood flow towards ensuring that muscle soreness is diminished. In order to lessen soreness, the KT can be taken into consideration for the creation of a low pressure area that enables movement of pain, diminishes localized pressure, enhances circulation and promotes lymphatic passage, thereby reducing muscular swelling (Harry, 2017). KT is commonly used to alleviate pain as well as preventing injuries and their recurrence in the rehabilitation of sports area (Lee et.al, 2015).

2.7. Cross Tape

CT is a relatively new form of therapy available for practitioners today. CT are tiny polyester tapes containing an adhesive acrylic coating. The CT are water resistant, free of medication and active ingredients. These tapes can be used for local points of pain, trigger or acupuncture points, painful joints and sore muscles (Halski et al, 2015). These tapes are applied directly over the point of pain and can adhere to skin for a period of several days. According to Sissel Therapy shop, Japan widely utilize Cross taping therapy where they cure muscle pains and enhance movement for people with mobility challenges. Besides, it is possible to achieve myofascial release in case of fibrosis. These results may be of serious interest in athletic health care delivery since scientific evidence suggests that pain may cause alterations to joint neuromuscular control and joint kinematics.

Toomac solutions similarly argues that Cross taping is a common practice among the Chinese and the Koreans whereby, the Chinese therapists believe that the energy in the body is free flow and such free flow of energy can experience disruption due to injuries. Cross taping them can normalize this disruption of the energy and bring it back to normal.

Lee et al. in their study on the effects of Spiral taping on balance when they apply it on the neck and ankle supports that the therapy has an impact on the body energy. In their study, they involved university student on which they carried their study at the intervals of one week. They found that Cross taping has a positive influence on the body balance.

“There no definite explanation for the effect of the CT. Possible factors could be:

1- The material of the cross tapes is not stretchable, that let the upper skin can not longer be moved. The irritation in this "area", therefore, either completely absent or only slightly present (movement of the skin provokes an irritation beneath the skin).

2- A present "adhesive force" would be possible (difference of a potential value, which causes a piezo electric effect), which is balanced by the reduction of movability under the CT and the movability of the surroundings. This proposal is, however, only very hypothetical.

3- In approximately 80% of all cases an acupuncture point is in a part of a fascia that is cut through by a nerve's terminal branches. This spot is going to be released because of the fixation of the upper skin” (Fransen, 2017). However, there lacks enough quality research done on the effectiveness of CT and much of the information is available on manufacture's websites.

2.8. Acupuncture Treatment

Even though DOMS cannot be prevented, needling at classical acupuncture points and tender points is more efficacious than sham acupuncture or no acupuncture in reducing perceived muscle soreness. The needling is referred to as acupuncture and is the stimulation of certain specific acupuncture points on the body skin using thin needles. It is an alternative form of medicine that is mostly used for pain relief. It is usually linked with the application of pressure, laser light or heat to those points.

Consultation is usually followed by taking both arms pulse and inspection of the tongue in modern acupuncture. This first evaluation may go up to sixty minutes and subsequent visits usually last for about thirty minutes. Most practitioners do not agree that only one session is sufficient, but the frequency and number of acupuncture sessions vary.

According to traditional Chinese acupuncture, energy usually flows through our body, 2mm lying underneath the skin, in a railway like system known as meridians, and a continuous cycle. Spinal problems, Scars or other illnesses may lead to disturbances in the flow of energy and trigger storage of energy. Patients who seek acupuncture do so for musculoskeletal problems which include shoulder stiffness, knee pain and low back pain. In most cases, acupuncture is used in conjunction with other treatment modalities.

2.9. The Different Effect of CT, KT, and Acupuncture Treatment on Pain and Muscle Soreness

A CT, a KT and (medical adhesive tape) a sham applications of tapes found that none influenced the inactive bio-electrical movement of upper trapezius muscle as the application of an

acupuncture treatment. Although all the treatments were effective in reducing chronic pain in the area of application and other related aches, the application of CT did not result in a diminution in muscle tenor in the case of myofascial trigger points (Halski et al., 2015). The bio-electrical movement of the UT muscle that is measured before all the treatments are applied helps in evaluating the relaxation achieved in the four interventions. The CT applications incorporate skewed evaluation of pain using visual analogue scale (VAS). Therefore, the outcomes of CT application in terms of bio-electrical movement of UT muscle are only assessed by surface electromyography (sEMG). This allows comparison between CT applications and acupuncture treatment on the basis of pain relief. There are secondary significant differences found in the three tapes applications that do not feature in the acupuncture treatment. For instance, scientists report that the KT application through its analgesic pressure reduces the subjective pain sensation more than the CT and sham application.

However, in the comparing the KT application individually with acupuncture treatment reveals that since the two have a huge disparity they would require continuous measurements to determine the most effective treatment (Morrissey, 2016). It is also suggested that to determine the overall therapeutic effect of CT applications they should be compared with other therapy methods of MTRPs.

To determine whether possible effects in the application of the three tapes and acupuncture treatments are long-lasting, continued evaluation is required even after the treatment period has ended. This is due to the pressure applied on bio-electrical motion of muscles with MTRPs, pain, and cervical ROM. Scientists suggest further verification of the possible effects of the CT application methods can be determined more accurately by using a larger number of participants of different pain variations. Also, more objective measurement tools should be used and in some cases the treatments should be applied severally, ten times at least, and on supposed anti-pain trigger points (Bae et.al, 2014). On the other hand, in acupuncture treatment pain threshold can be measured before, during and after the treatments. This is done randomly by a physician who uses algometry on the patient pain threshold (PPT) regions. It is evident that with acupuncture treatments the possible effects are long lasting, with relief being realized even three years after the treatments (Morrissey, 2016). However, it has also been noted that the first six months after the beginning of the treatment, the PPT of some muscles rarely decreases. Most treatments have observed no change in the PPT of the muscle with a few cases showing that the PPT of some muscles rose in the half year after commencing the treatments. All in all, adequate treatments using either CT applications and acupuncture have been proven to reduce chronic pain in the trigger points with the effect lasting for more that twelve months.

CT applications become effective as pain changes through artificial induction over the time the treatment is carried out. Through quantitative sensory testing (QST), the applications are tested for DOMS on the non-dominant biceps brachii. For

instance, if DOMS is stimulated through unconventional exercise the subjective assessment of CT is applied. On the other hand, acupuncture treatment on DOMS lowers pain evaluation in reaction to calibrated stimuli.

However, it is important to note that acupuncture's pain-relieving results on tentative pain may be dependent on both the individual and the mode of treatment used (Halski, et al., 2015). The manual acupuncture mode of treatment has recorded results of exceedingly noteworthy analgesia. On the other hand, electro, placebo, and subjective modes of acupuncture show relatively lesser pain-relieving results with significant correlations. The consciousness provoked by these acupuncture modes of treatment result in putative therapeutic effects. The sensation provoked is complex since with the variety of subjects used each mode of treatment display different ratings in multiple descriptors. For instance, the subjective mode of acupuncture displays different ratings in treatments of numbness and soreness (Morrissey, 2016). Conversely, the subjective mode does not have these results in the ratings of aching, heaviness, and throbbing. This is an indication that extensive and clear cut research should be conducted on the attributes of the sensation provoked by CT applications and acupuncture treatments to help in determining valuable clinical indicators of effective treatment.

Though there is only very minimal research on the effectiveness of muscle soreness, Cross taping is said to adjust the balance of the human body as it can be applied to the muscles, acupressure and trigger points. The manufacturers posit that the therapy is effective for pain relieve in muscles and joints.

A study conducted to determine the effectiveness of Kinesio taping and Cross taping, a proper tape was applied on patient upper body muscle for three days. However, there was failure to identify significant effect of Kinesio taping and Cross taping on muscle bioelectric activity. As such, the effectiveness of Cross taping is still contentious as per the study. More research needs to be done to determine the effectiveness of the same on DOMS.

3. Methodology

In an attempt to come up with answers to the research questions, experimental research will be carried out. The nature of the research will be qualitative to come up with the best possible solutions to the questions. With the use of an experimental team, the ability to manipulate the factors being tested will be fully exploited. Twenty normal subjects who have no history of any previous skin allergy from any tape and do not have any upper body injuries subjected to carrying out the experiment.

3.1. Subjet Selection

Data will be gathered at Wichita State University, Wichita, Kansas, USA in 2015. Subjects were a volunteers of 20 (15 males and 5 females), with age ranging from 18-55 with mean age 25.25 years.

3.2. Instrumentation

Dumbbell, a gymnastic apparatus consisting of two wooden or metal balls connected by a short bar serving as a handle, used as a weight for exercising (figure 2). All rest time was adjusted by using the timer (figure 3). Goniometer, An instrument look like full-circle protractor made of transparent plastic was used for angle measurements, to ensure appropriate reliability; use it to measure the flexion of shoulders and elbows (figure 4). Cross tape (figure 5). McGill, Pain Questionnaire used to evaluate a person experiencing significant pain (figure 6).



Figure 2. Dumbbell.

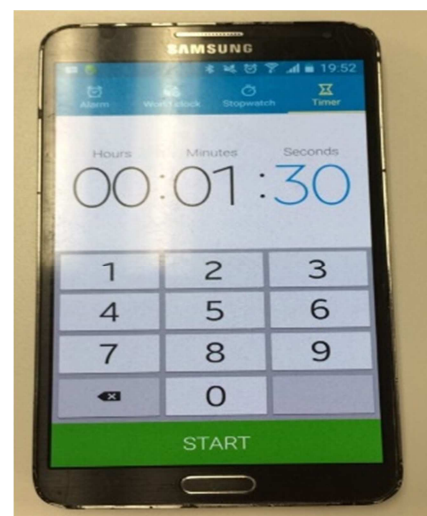


Figure 3. Timer.

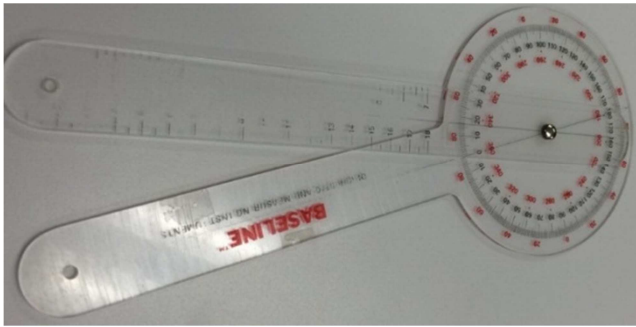


Figure 4. Goniometer.

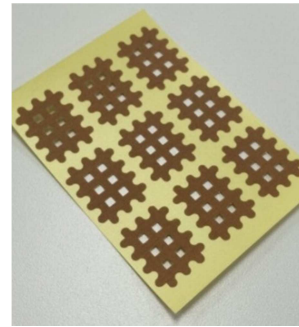


Figure 5. Cross tape.

Pre: (15) AM

Post: No pain

The McGill Pain Questionnaire

The McGill Pain Questionnaire can be used to evaluate a person experiencing significant pain. It can be used to monitor the pain over time and to determine the effectiveness of any intervention. It was developed at by Dr. Melzack at McGill University in Montreal Canada and has been translated into several languages.

Sections:

- (1) What Does Your Pain Feel Like?
- (2) How Does Your Pain Change with Time?
- (3) How Strong is Your Pain?

Circle the number for the left arm and underline the number for the right arm.

(1) What Does Your Pain Feel Like?

Some of the following words below describe your present pain. Circle ONLY those words that best describe it. Leave out any category that is not suitable. Use only a single word in each appropriate category - the one that applies best.

Group	Descriptor	Points
1- (Temporal)	Flickering	<u>1</u>
	Quivering	(2)
	Pulsing	3
	Throbbing	4
	Beating	5
	Pounding	6
2- (Spatial)	Jumping	1
	Flashing	2
	Shooting	3
3- (Punctate pressure)	Pricking	1
	Boring	2
	Drilling	3
		3

Figure 6. McGill Questionnaire.

3.3. Procedure

3.3.1. Testing Procedures

The study will take place in the Human Performance Lab, Heskett Center at WSU. Each subjects who met the criteria for inclusion in the study were perform the lowering phase of a biceps curl exercise using a dumbbell consisting of 3 sets 25

repetitions, followed 90 seconds of rest between each set. Cross tapes will then be applied (figure-6) on the biceps of the dominant hand and the other hand as control for one week. The ROM of shoulders and elbows flexion for both arms will be measured after exercise. Each subject positioned stand up right during perform the exercise, measured the ROM and set during rest, applied the tapes. In the next day, when the

participants start get muscle soreness, they will fill up the pain Questionnaire.

3.3.2. Tape Application

Apply Crosspatch with wooden spatula diagonally at an angle of 45 on the appropriate area (figure 6), for stimulating the drainage of the lymph (Esther, 2013).



Figure 7. Cross tapes applying.

3.3.3. The Follow up Session

After one week, the ROM of shoulders and elbows flexion for both arms will be measured again in this session and fill up the pain Questionnaire as post, if there is still pain.

4. Data Analysis

Prior to data collection, the comparison between groups of the Measurements of range of motion and pain using the procedures described was evaluated using a Repeated Measures ANOVA design in SPSS program. Five female subjects with a mean age of 30 years (SD=14.61), fifteen male with mean age of 23.67 years (SD= 4.43). One week separated the first and second measurements, Mean values were 321.66 degrees (SD=33.16) for the pretest measurements and 307.29 degrees (SD=20.36) for the posttest measurements. The confidence interval as.95% for the measurements taken 1 week apart, Rt 101.699;105.734, Lt 103.91;107.94.

5. Results

The purpose of the study is to assess the efficacy of the Cross tapes for one week in muscle soreness.

Table 1. ROM on both arms.

Arms	Mean Pre	Mean Post	SD Pre	SD Post	p-value
Rt Shoulder	151	165.8	8.52	9.16	0.00
Lt Shoulder	154	162.45	10.83	9.39	0.00
Rt Elbow	131.5	143.2	7.09	3.74	0.00
Lt Elbow	132.25	138.25	7.16	6.54	0.00

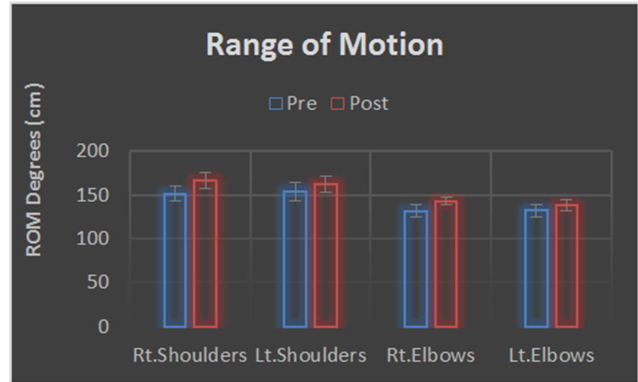


Figure 8. ROM on both arms.

In table 2 as shown below also there is an extremely significant difference between pre and post applied CT on pain Questionnaire in term of Biceps soreness.

It also shown in figure 8.

Table 2. Pain Questionnaire.

Biceps	mean Pre	mean Post	SD Pre	SD Post	p-value
Right	29.3	1.5	14.61	14.61	0.00
Left	45.25	3.35	14.25	14.25	0.00

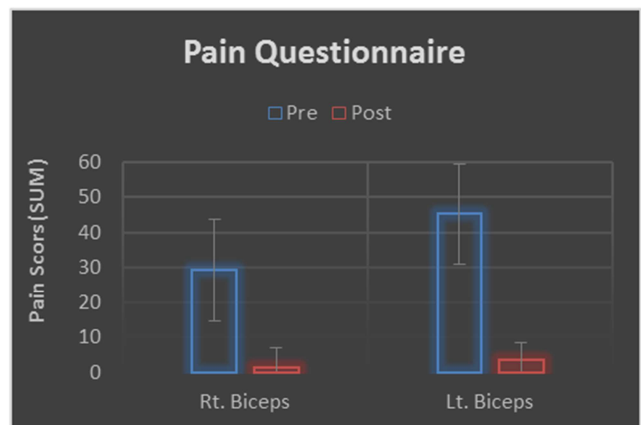


Figure 9. Pain Questionnaire on both Biceps.

A one-way within-subjects ANOVA was conducted with the factor being applied the CT on the right and left arms. The dependent variable being the Pain scores and ROM degrees. The results for the ANOVA indicated a significant CT effect, Greenhouse-Geisser = 2738.52, $F(5, 19) = 7.28$, $p = .00$, multivariate $\eta^2 = .16$ and round up to .2 which is a large effect size and the Power is .96 which is strong. Follow-up Pairwise test comparisons indicated a significant effect for all factor compares, with the means increasing over the ROM and decreasing over the pain. However, tests of between-subjects of the right and left arms indicated no significant, 292.60, $F(1, 38) = 2.46$, $p = .13$ with medium effect size .1 and weak power .33. Furthermore, the 95% confidence interval for the mean difference for right to left was -5.1 to .65.

These findings indicate that the cross tape declines the risk of an injury which is decrease the pain. Furthermore, the ROM

that have not have a big difference after one week.

6. Discussion

Muscle soreness is an important component of physical fitness, and increase muscle soreness can cause inefficiency in the workplace and is also a risk factor for injury. Cross tape was reported to be an effective method for decreasing muscle pain. The outcome of this study revealed that the application of a CT was effective as a means of reducing the DOMS. The findings of this study are consistent with other literature that reported equal significant decreasing muscle pain (Halski et al, 2015). However, within-subjects ANOVA revealed significant changes in the ROM and Pain when applied CT on the arms, while there was no significant difference in the between- subjects ANOVA of the right and left arms that because the sample small. These results reject the Null hypothesis and suggest that CT produce good effect on DOMS for athletes.

7. Conclusion

The study findings show that there were statically significant difference between the ROM and the pain (pre, post) when the procedure is carried out over a period of two consecutive weeks (1 day per week) with large effect size (0.2) and strong power (0.96). However; there were no significant differences between the two groups (right, left arms) with medium effect size (0.1) and weak power (0.33). Therefore we conclude that in order to improve the functional performance, this study suggest that CT may reduce DOMS, however more research is needed. Future studies should include a larger number of subjects, more diverse cohort, an exercise that applies a greater intensity, and expands the time of research.

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