The effect of tape application to fascial planes on muscle contraction

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Abstract

Introduction: Kinesio Taping ® applications have been used by numerous medical practitioners to reduce the tension and adhesions of the fascia. Kinesio tape manufacturers claim that the reduction of tension and increase of space between the dermis and for optimal muscle contractility. The purpose of this study was to determine the effects of Kinesio Taping ® on muscle contractility when compared to no tape and Elastikon taping applications.

Methods: Three taping procedures (Kinesio Taping ®, no taping, and Elastikon taping) were applied to the flexor group of the forearm in this study. A hand dynamometer was used to test the grip strength of all participants.

Results: Significant increase in strength was noted between the Elastikon group vs. Kinesio Tape ® group in the male subjects. No significant differences in strength were noted between the control group and the Kinesio Tape ® wearing groups in the male and female subjects.

Conclusion: The results suggest that the application of Kinesio Tape ® to the flexor group of the forearm could increase the strength of muscle contraction in healthy adults.

Introduction

Taping procedures have been the subject of many research studies over the past several decades in the field of sports medicine. There have been several theories about the effects of taping on injury prevention and athletic performance. The Kinesio Taping ® manufacturing companies claim that the taping application allows the body to move normally as it reacts to the fascia of the body through biomechanical and proprioceptive mechanisms. Kinesio Tape ® can be applied in a variety of patterns, which is determined by the patient's injury and the outcome that is desired.[1]

Fascia forms the biological container and connector for every organ in the human body, including muscles.[2] Facial tissues create anatomical envelopes that separate the body's muscular layers. They are composed primarily of collagen connective tissue fibers which intersect with each other at 45 degree angles forming a lattice pattern. In addition to collagen fibers, fascia is also made up of elastic fibers. The elastic fibers make it possible for the fascial tissue to return to its original form after it has been deformed. The proportion of collagen and elastic fibers within an area of fascia depends on the functional demands that are placed on tissue area. If there are strong tensile stresses placed on the area then the collagen portion will dominate the elastic fibers. Elastic fibers will dominate collagen fibers in an area that undergoes repetitive movements. The fascial system is able to adapt to changing functional requirements of the body over an entire lifetime.[3]

It is difficult to discuss the fascia separately from muscle fibers within the musculoskeletal system from a functional standpoint. Every cell in the human body is linked to and responds to the tensional environment of the fascia.[4] There is no muscle tone without a corresponding tensing of the fasciae and no tensing of the fascia without muscle tone. Most ligaments are dynamically integrated with the muscles in series so that muscle contraction helps the ligaments stabilize the joints at all angles.[5] Therefore, muscle contractions, which tense the muscle and myofasica, also tense the associated ligaments because they are part of the same series of fascia. During muscle contractions the muscle itself is not a separate underlying layer but work as a functional unit within the body due to its connection to fascia.[6]

The connective tissue of the fascia is a living, responsive, semiconducting crystal lattice matrix which stores and distributes mechanical information. The fascial system conveys mechanical information through the interplay of tension and compression along the fibrous net. For this reason it is considered one of three anatomical networks that govern and coordinate the human body. [7] The body's myofascia provides a continuous network of restricting but adjustable tension around the individual bones and cartilage as well as the organs and muscles which push out against the restricting tensile membrane. Tensional forces naturally transmit themselves over the shortest distance between two points. This allows for the elastic parts of the structures to be in the optimal position to withstand the applied stresses that are placed on the body.[7]

Kinesio Taping ® has been used by medical practitioners to reduce the tension and adhesions in fascia. [8] According to Larry Tillman, an associate physical therapy professor at the University of Tennessee Chattanooga, adhesions form when the fascia suffers injury and the fascia connective tissue becomes disorganized. When there is disruption to the fascia due to adhesions the transmission of the muscle contraction cannot be optimally completed thus leading to a weaker

contraction. This weaker contraction occurs due to the fibers of the muscle not being optimally lined up with the fascia.[9] Furthermore, when an area of the body is not stimulated by movement the chronic muscular tension of the adhesion cuts off capillary circulation to the area. When circulation is decreased the normal gel-like continuity of the connective tissue matrix takes on a glue-like continuity which creates further adhesion as the connective tissue fibers lay down a thickened matrix due to the increased tissue stresses.[10]

Recently, many research studies have been done to determine the effect of Kinesio Taping ® on muscle strength. The results of these studies have demonstrated mixed results. A study conducted by Murray found that the Kinesio Taping ® application increased the activity of the quadriceps muscles in patient who had undergone an ACL repair during the postoperative phase of rehabilitation.[11] However, Tieh-Cheng Fu and his colleagues found that Kinesio Tape ® does not influence muscle strength when applied to the knee of healthy athletes. In this particular study, fourteen healthy young athletes, seven males and seven females, free of knee problems were used as subjects. Muscle strength of each subject was assessed with an isokinetic dynamometer under three conditions: without taping; immediately after taping; 12 hours after taping with the tape remaining in situ. The results of the study revealed no significant difference in muscle power among the three conditions.[12] Janwantanakul and Gaogasigam also did not find any effect of Kinesio Tape ® on muscular activity when applied to the vastus laterialis and medialis muscles.[11] Thus the purpose of this study was to determine if the manipulation of fascial planes with different tape applications on asymptomatic individuals had any effect on the strength of muscle contraction as well as if a specific type of taping application had an effect on changes in contraction force.

Methods

Institutional Review Board approval was obtained through Logan College of Chiropractic for human subject testing. Before any testing each participant signed an informed consent form that was witnessed by a member of the research team.

Participants

A convenience sample of 48 healthy individuals was obtained from the student population of Logan College of Chiropractic. Individuals with any history of surgery to the wrist, elbow, or shoulder as well as individuals with recent history of injury in the past year were excluded. Any person with any allergy to any adhesive product was excluded due to possible reactions with any of the tape. Procedure for testing utilized the dominant hand. Hand dominance was determined by the hand used for the majority of daily activities.

Taping Technique

The tape was applied by four senior chiropractic interns familiar with the use of these tapes as well as having specific training in the prescribed taping method. All taping procedures were followed as described in Clinical Therapeutic Application Kinesio® Taping Manual 2nd edition. The procedure used was to facilitate contraction of the flexor muscle group in the forearm. First, each subject was measured from the medial condyle of the elbow to the tip of the third digit of

the hand. It was determined that 50% of that total length would be used for standardization purposes. Each subject was asked to make a fist and flex their wrist. Tape was applied from just distal to the medial condyle to mid forearm where the patient slowly took the hand back to neutral, then slowly extended both wrist and fingers. Tape tension was placed subjectively at 50% tension. To lay down the Kinesio Tape ® the intern slowly applied 50% tension while pulling off the backing, with the other hand the tape was smoothed down. The ends of the kinesiotape were rounded to better follow the instructions of the book on tape application. With the Elastikon tape there is no backing, so tension was applied at a similar level of approximately 50% tension based on examiner technique. The ends of the Elastikon tape were not rounded due to the difficulty in maintaining the integrity the tape. The final step was each taping procedure was rubbed by the examiner to improve adherence to the subject's skin.

Measures

Each subject was measured from medial condyle of the elbow to the tip of their third digit. Each patient's height and weight was obtained as part of their entrance survey. Arm measurements were taken using a simple tape measure. All grip strength was measured using an analog grip strength dynamometer (Sammons Preston Rolyan, JAMAR, Model 5030JI, Nottinghamshire, NG UK) supplied by the Biofreeze Center of Logan College of Chiropractic. Each participant was randomly assigned to one of three groups; control, Kinesio Tape ®, or Elastikon tape. The randomization was done by placing the participants name in a hat and drawing each name out one at a time.

Each participant was given the grip strength dynamometer and asked to perform three maximal exertions with the grip strength dynamometer. Each participant received 60 seconds rest between each of the three attempts. Following the initial exertion, based on the group assigned, the participant was taped or asked to wait 30 seconds. They were then maximally tested three times again. Each set of data was then averaged to find a before and after average grip strength. The grip strength dynamometer was adjustable to fit into the participants hand to allow a more comfortable test. Each participant was instructed on how to properly hold the instrument in an effort to replicate the test.

Our study was conducted on 51 participants on 2 separate days. Day one concluded with 32 participants completing the study. The rest of the participants completed the study on day two. The participants were separated into three groups; a Kinesio Tape ® an Elastikon, and a control group. The 51 participants were split into equal groups with 17 participants in each group. Each group consisted of 9 males and 8 females. Each participant's grip strength was taken prior to application of taping protocol and again after the taping protocol was applied or after 60 seconds of rest (for the control group). The individuals were asked to grip the hand dynamometer maximally three times with their dominant hand; with each grip recorded in a table; afterwards the three grip strength measurements were combined to get average grip strength. After time of application of tape, the participants were asked again to maximally grip the dynamometer three times with each grip strength recorded. They were then combined to find average grip strength per participant.

Results

All data plots were put into an excel spreadsheet, where they were averaged to obtain an average pre-test, and an average post-test. The p-values were then calculated to determine a statistical significant difference. Using Microsoft Office the data plots were placed in tables to demonstrate variability between the Kinesio Tape ®, Elastikon, and control groups.

Tables 1 and 2 demonstrate the differences between male and female subjects with the different taping applications. The male subjects who wore the Elastikon tape had a significantly weaker contraction while wearing the tape in comparison to the force of their contraction before the Elastikon tape was applied. There was no significant difference noted in the muscle strength with Elastikon, Kinesio Taping ®, and the Control groups ($p < 0.05$) in the male and female test subjects after the tape was applied. The male sub-group of Kinesio Taping ® was the only group to show an increase in mean grip strength from pre- to post- treatment; with the female subgroups Elastikon and Kinesio Taping ® demonstrated no change in mean grip strength between pre- and post- treatments. When comparing the groups inter-respectively there was only on comparison that showed any statistical significance and that was between the comparison of Elastikon and Kinesio Taping ® groups. The differences between pre and post treatment grip strengths were first calculated to determine if there was a statistical significance inter-respectively between groups.

Table 1. Average muscle strength in male subject's pre and post taping application

Taping application	**Mean Strength Pre-taping (lb)**	**Standard Deviation pre-taping**	**Mean Strength Post-taping (lb)**	**Standard Deviation Post-taping**	**P-Value Comparison Pre- vs. Post-treatment**
No tape	112.036	15.93776	110.7407	18.56129	p = 0.87569
Elastikon	107.4074	3.86012	102.7778	10.99242	p = 0.39724
Kinesio Taping ®	122.5936	15.68153	124.4444	15.7233	p = 0.80564

Table 2. Average muscle strength in female subject's pre and post taping application

Taping application	**Mean Strength Pre-taping (lb)**	**Standard Deviation pre-taping**	**Mean Strength Post-taping (lb)**	**Standard Deviation Post-taping**	**P-Value Comparison Pre- vs. Post-treatment**
No tape	70	10.46536	68.95833	11.91696	p = 0.85529
Elastikon	63.125	9.57168	63.125	9.61305	Undetermined
Kinesio Taping ®	73.54167	9.69526	73.54167	11.2489	p = 1

Table 3. T-Test comparison of the inter-relationships between groups for males using the difference between the pre- and post- grip averages

No-tape vs. Elastikon	No-tape vs. Kinesio Taping ®	Elastikon vs. Kinesio Taping ®
p = 0.26208	**p = 0.22932**	**p = 0.0088**

Table 4. T-Test comparison of the inter-relationships between groups for females using the difference between the pre- and post-grip averages

No-tape vs. Elastikon	No-tape vs. Kinesio Taping ®	Elastikon vs. Kinesio Taping ®
p = 0.57923	**p = 0.60442**	**p = 1**

Discussion

The results of this study demonstrated that the application of Kinesio Tape ® to the flexor group of the forearm does increase the muscle contractility and strength in the male test subjects. There was a statistically significant difference between the male test subjects who wore Elastikon vs. the subjects who wore the Kinesio Tape ®. The male test subjects who wore the Elastikon had a significantly weaker muscle contraction while wearing the Elastikon when compared to the strength of their contraction before the Elastikon tape was applied. There was however no statistical significance between the male and female subjects who did not wear any tape vs. the subjects who wore the Kinesio Tape ®.

The direction to which the Kinesio Tape ® is applied has an effect on muscle tone. When the Kinesio Tape ® is applied to the muscle from origin to insertion, the tape acts in a supportive manner to improve muscle contraction and increase strength.[13] The application of Kinesio Tape ® to the skin induces a tactile summation in the muscles. The tactile summation interacts with the central nervous system in order to control body movement. Fascia plays a vital role in the transmission of mechanical tension from the muscles, which then serves to regulate body movement and posture.[14] The Kinesio Tape ® serves to assist in the realignment of the fasica and muscle fibers. Optimal contraction occurs when the muscle fibers are in parallel can thus a larger number of fibers are able to contract together created a stronger muscle contraction.[9]

Kinesio Tape ® enables the fascia to be unloaded. The tension between the fascial layers increases in response to the mechanical loading that is applied to the tissues during movement. [15] Fascia also contains a contractile component as it uses proprioceptive signals to assist in load bearing activities.[16] The objective of applying Kinesio Tape ® is to facilitate muscle relaxation by lifting the skin and increasing the subcutaneous blood flow and lymphatic drainage. This helps to stimulate a larger muscle contraction because it allows for more oxygen to reach the muscle tissues. Kinesio Tape ® placement along the muscle fascia allows the muscle and fascia

to work collectively creating optimal conditions for neurological signaling, muscle contraction, and body movement.[13]

The taping properties of Elastikon are different from Kinesio Tape ®. While Kinesio Tape ® is used to help facilitate an increase in range of motion; Elastikon is used in restricting range of motion. Traditionally Elastikon is used to promote stability to a body area, particularly the joints, by limiting the joint's range of motion. The application of Elastikon creates a compressive tension to the body area which does not allow easy contractility of the muscle fibers which lie under the Elastikon taping application. This therefore caused a weaker muscle contraction in the subjects who wore the Elastikon taping application.[17]

One of the puzzling findings of this study was that while there was a significant difference in muscle contraction in the male subjects who wore the Kinesio Tape ®, there was no significant difference in muscle contraction in the female subjects who wore the Kinesio Tape ® (female $p = 0.06$). One speculation as to why this occurred would be that men typically have a greater muscle mass than females. The fasical tissue may have adhered to more muscle tissue in the male subject population leading to a higher surface area of muscle tissue for a greater contraction. The application of the Kinesio Tape ® allowed for a greater pull on the fascial tissue and essentially a larger muscle contraction.[18] Another speculation to the smaller contraction size in the female subjects is that hormones may play a role in the function of fascia and muscle contractility.[19] Further study could be done to see if the menstrual cycle has an effect on muscle contractility in women.

A limitation for this study includes the fact that the subjects were not blinded to which tape was applied to their forearms. This may have influenced the effort put forth by the test subjects because of the tape they were wearing during the testing procedure. The tension at which the tape was applied was subjectively 50% but was not specifically parameterized in this particular study. In future studies tape tension needs to be parameterized.

Conclusion

This study found that there is a statistical significance between the male test subjects that wore the Elastikon tape and the subjects that wore the Kinesio Tape ® with the p-value between the differences of these groups being less than 0.05 at 0.008. The male subjects who wore the Kinesio Tape ® demonstrated a greater strength of muscle contraction than the subjects that wore the Elastikon. The male test subjects who wore the Elastikon demonstrated a weaker muscle contraction while wearing the Elastikon when compared to the strength of their contraction before the Elastikon tape was applied. Kinesio Tape ® application does improve the strength of muscle contraction, which has benefits for the rehabilitation process and athletic performance at least in the male population. However, there was no statistically significant change in grip strength when comparing the pre and post averages between groups introspectively.

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