Kinesio® Tape's Effect on Muscle Strength of a Chronically Injured Ankle Sprain

by

Hammond, Kristian; Leach, William; Lo, Jerry; Popa, Marcel; Taylor, Travis

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Faculty Advisor: Patrick Montgomery DC

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Abstract:

Objective: To determine if Kinesio® Tape is effective in strengthening a chronically unstable sprained ankle using a Dynamometer reading.

Methods: Seven patients (all males) were measured using a dynamometer using both their injured and un-injured ankles. Participants were then taped on both ankles and re-tested 3 days later.

Results: The mean ankle muscle strength for both the Ankle Injury Group and the Non Injury Group were greater in Day 4 (Post Kinesiotape measurements). In the Injured Group, the only statistically significant differences were found between the Pre-Kinesiotaped ankles and Post-Kinesiotaped ankles when the foot was tested in dorsiflexion ($p=0.026$), internal rotation($p=0.041$) and external rotation ($p=0.012$). In the Non Injured Group, the only statistically significant differences were found between the Pre-Kinesiotaped ankles and Post-Kinesiotaped ankles when the foot was tested in plantar Flexion ($p=0.022$) and dorsiflexion ($p=0.041$).

Conclusions: This study concludes that Kinesio® Tape did not have a statistically significant effect on strengthening the ankle joint when testing the ankle muscle strength in plantarflexion, dorsiflexion, internal and external rotation using the Dynamometer. This study offers information that may stimulate new design of ankle taping methods by using different testing strategies and further research may help to reduce uncertainty of the effects of Kinesiotaping on functional performance.

Key Words: *Kinesiotape, Ankle Sprain, Dynamometer*

Introduction

Ankle sprains are common among everyone from athletes to the common person on the sidewalk. According to the National Electronic Injury Surveillance System (NEISS) an estimated 630,891 ankle sprains occurred[1]. Ankle sprains develop into functional ankle instability in 20-40% of cases[3-5]. This prevalence warrants research in the ways to stabilize these ankle injuries. Functional ankle instability is clinically important because it prevents approximately 6% of patients from returning to their occupations and 13% to 15% of patients remain occupationally handicapped for at least 9 months and up to 6.5 years after injury[6].

Kinesiotaping is a textured, elastic tape that is applied over a muscle and will reduce pain and inflammation, relax overused or tired muscles, optimize performance, and support muscles in movement on a 24-hour-a-day basis. Kinesiotape® provides stability and support to the muscles and joints without restricting range of motion[2].

Methods

Our study's purpose is to determine if Kinesio® Tape can affect muscle strength in an unstable ankle. We defined unstable ankle as someone having sustained an ankle sprain over 6 months ago in time. Our exclusion consisted of any ankle injury or pathology that required surgery of the ankle joint, history of hip or knee injury, loss of limb, an ankle sprain in the last 6 months, a positive Ottawa ankle rules tests (this test asses fractures in the ankle), sensory deficits in the lower extremity between the two legs, circumferential differences between the two ankles of more than 1/2 inch, a negative talar tilt or anterior drawer test, abnormal gait and any bruising, discoloration or scarring.

We advertised this study to the study population of Logan College of Chiropractic. Our study consisted of two days of measurements. We utilized three rooms in the assessment center at Logan College to conduct our study. On the first day the participants came in on a pre determined time to be evaluated. We received written consent to perform the study on the individuals. Then the participants answered a screening questionnaire. See Appendix A

Ankle Examination

This exam was used to evaluate an exclusion criteria, which was explained previously.
The participant also informed a group member, one of which that was not performing an exam, which ankle was the unstable ankle.

After that was completed the participant entered the first room where an examiner performed a physical exam. The exam consisted of the following:

After the ankle exam was completed the participant moved into the second room where an examiner evaluated the strength of the ankle joint in four range's of motion: dorsiflexion, plantarflexion, internal rotation and external rotation. We used a hand held dynamometer to assess strength in each motion. The machine is called "The Lafayette Instrument Muscle Testing System," which is a handheld manual muscle-testing device. It measures the pounds of pressure put on a padded stirrup. The test subject presses on the stirrup in the desired range of motion for 10 seconds until an audible beep is heard which is when the reading is complete. A wood box was used to stabilize the Dynamometer so that our examiner couldn't push against the participant and alter the results. In plantarflexion the dynamometer was put on the top of the box (Figure 1), on internal (Figure 3) and external rotation (Figure 2) it was put on the right and left of the box. Dorsiflexion (Figure 4) was done with the patient prone on the table with the dynamometer at the end of the table. Our examiner did this test while another examiner recorded the information. The examiner testing the subject did not know which ankle was the unstable ankle.

Figure 1 - Plantarflexion

Figure 2 – External Rotation

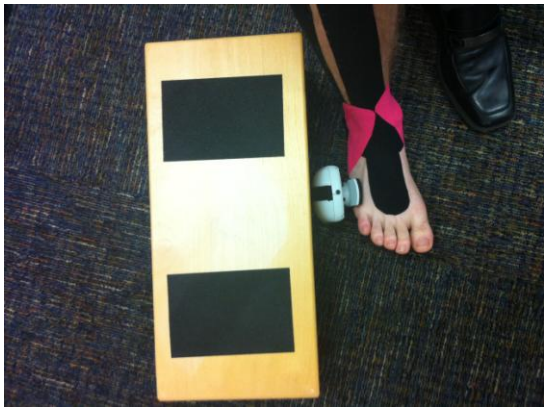
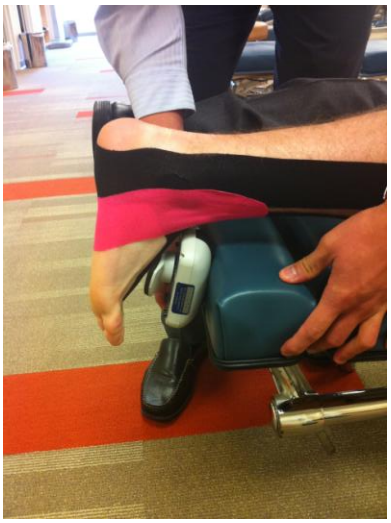


Figure 3 – Internal Rotation

Figure 4 - Dorsiflexion



After the muscle testing was completed, the participant moved onto the third and final room where the Kinesio® Taping occurred. For each subject we used 16 inch I strips, 2 12 inch I strips and 1 6 inch I strips to tape both ankles. The method we determined to use came from the book, "Kinesio Taping Perfect Manual by Kinesio Taping Association." The authors of this book included Kenzo Kase. DC, Tatsuyuki Hasimoto. Ph.D and Tomoki Okane. The examiner performing the taping was certified Kinesio tapers who had completed a 100-hour course previously. We then told the participant to leave the tape on and come back 3 days later to retest their muscle strength.

After 3 days of having the Kinesio Tape on their ankles, the participants came back to the assessment center at a pre determine time. The participant entered a room where one of the examiners measured the strength of the both ankles in the same four ranges of motion: dorsiflexion, plantarflexion, internal rotation and external rotation. Another examiner was in the room and recorded the data. After the measurements were made, the participants were finished with the study and were allowed to leave and remove the Kinesio® Tape

Results

During the study 7 ankles sprains were reported. One participant was excluded from the study because the Talar Tilt Test and the Anterior Drawer Test were negative. The exact measurements of the ankle muscle strength in plantarflexion, dorsiflexion, internal and external rotation are presented in Tables 1, 2, 3, and 4. Means and standard deviation scores on each of the muscle tests are also presented in each of the tables.

The mean ankle muscle strength for both the Ankle Injury Group and the Non Injury Group were greater in Day 4 (Post Kinesiotape measurements). In the Injured Group, the only statistically significant differences were found between the Pre-

Kinesiotaped ankles (Table 1) and Post-Kinesiotaped ankles (Table 2) when the foot was tested in dorsiflexion (p=0.026), internal rotation (p=0.041) and external rotation (p=0.012). In the Non Injured Group, the only statistically significant differences were found between the Pre-Kinesiotaped ankles (Table 3) and Post-Kinesiotaped ankles (Table 4) when the foot was tested in plantarflexion (p=0.022) and dorsiflexion (p=0.041).

Table 5 describes the difference between the Pre-Kinesiotaped Injured Ankles (Day 1) and Pre-Kinesiotaped Non Injured Ankles (Day 1) as well as the difference between the Post-Kinesiotaped Injured Ankles (Day 4) and Post-Kinesiotaped Non Injured Ankles (Day 4). There were no statistically significant differences found between the two t-Tests.

Table 1. Ankle muscle strength using the Dynamometer in the Ankle Injury Group; Pre-Kinesiotape (Day 1)

Subject	Plantar Flexion	Dorsiflexion	Internal Rotation	External Rotation
1	30.5	45.1	33.5	25.6
2	21.4	14.1	13.4	15.9
3	26.6	18.7	18.7	15.9
4	17.9	24.6	10.5	18.8
5	31.4	36.3	15.1	13.0
6	19.2	21.1	15.8	21.2
Sum	147.0	159.90	107.00	110.40
Mean	24.50	26.65	17.83	18.40
STD DEV	5.82	11.74	8.14	4.51
t - Test	0.071	0.026	0.041	0.012

Table 2. Ankle muscle strength using the Dynamometer in the Ankle Injury Group; Post Kinesiotape (Day 4)

Subject	Plantar Flexion	Dorsiflexion	Internal Rotation	External Rotation
1	35.1	48.1	26.2	31.7
2	27.2	31	35.1	16
3	35.4	23.8	28.3	21.4
4	41.2	39.5	36.5	32
5	30.7	36.8	27.9	23.8
6	55.1	38.1	30.8	28.9
Sum	224.70	217.30	184.80	153.80
Mean	37.45	36.22	30.80	25.63
STD DEV	9.858	8.213	4.167	6.358

Table 3. Ankle muscle strength using the Dynamometer in the Non Injury Group; Pre-Kinesiotape (Day 1)

Subject	Plantar Flexion	Dorsiflexion	Internal Rotation	External Rotation
1	35.8	54.9	31.8	33.2
2	21.1	14.1	14.1	23.5
3	24.9	17.3	12.8	13.3
4	16.5	32.6	13.6	18
5	39	36.5	17.8	14.2
6	29.9	27.4	14.4	32
Sum	167.20	182.80	104.50	134.20
Mean	27.87	30.47	17.42	22.37

STD DEV	8.66	14.76	7.25	8.71
t-Test	0.022	0.041	0.084	0.622

Table 4. Ankle muscle strength using the Dynamometer in the Non Injury Group; Post –Kinesiotape (Day 4)

Subject	Plantar Flexion	Dorsiflexion	Internal Rotation	External Rotation
1	38.2	51.8	21.1	29.3
2	28.6	23.5	19.4	13.6
3	36.5	28.9	31.4	18.4
4	41.9	37.5	29.6	31.3
5	46	40.2	31	29.3
6	55	37.9	44.3	25.8
Sum	246.20	219.80	176.80	147.70
Mean	41.03	36.63	29.47	24.62
STD-DEV	8.99	9.77	8.92	7.07

Table 5. t-Tests comparing pre and post groups (significance at $p<0.05$).

t-Test 1: Pre-Kinesiotaped Injured Ankles (Day 1) vs Pre-Kinesiotaped Non Injured Ankles (Day 1)

t-Test 2: Post-Kinesiotaped Injured Ankles (Day 4) vs Post-Kinesiotaped Non Injured Ankles (Day 4)

	Plantar Flexion	Dorsiflexion	Internal Rotation	External Rotation
t - Test 1	0.176	0.108	0.773	0.133
t - Test 2	0.193	0.837	0.760	0.485

Discussion

In the research of "the strengthening effects of Kinesio® tape on unstable ankles" the null hypothesis may be stated as "Kinesio® tape will not have a strengthening effect on unstable ankles" and the alternate hypothesis may be stated as "Kinesio® tape will strengthen an unstable ankle". In this case, our research has shown that the null hypothesis will be accepted due to the fact that statistically significant data was not gained to support the argument that Kinesio® tape strengthens an unstable ankle.

Although the null hypothesis must be accepted in this case, the p-value of certain ranges of motion did demonstrate statistically significant proof that the unstable ankle, after being taped, had more strength than the pre-taped ankle. In the control group (non-injured ankle; pre and post taping) the p-values of plantarflexion, dorsiflexion, internal rotation, and external rotation were 0.022, 0.041, 0.084, and 0.622 respectively. For a comparative set of data to be deemed statistically significant, the p-value must be less than or equal to 0.05. This shows that a statistically significant increase in strength occurred in the control group from pre to post taping in plantarflexion and dorsiflexion, but no significant change in strength was seen in internal or external rotation. In the test group (injured ankle; pre and post taping), the p-values of plantarflexion, dorsiflexion, internal, and external rotation were 0.071, 0.026, 0.041, and 0.042 respectively. These p-values indicate that taping had no significant effect on increasing the strength of plantarflexion, but it did have a significant increasing effect on dorsiflexion, internal, and external rotation. Although many ranges of motion showed a significant increase in strength from pre to post taping, there was not a strong enough correlation between the changes in the healthy ankle and the injured ankle to accept the alternate hypothesis of "Kinesio tape will strengthen an unstable ankle".

Although this research was not statistically significant enough to reject the null hypothesis, it still shows a trend that may be further explored. As stated before, several ranges of motion showed a significant increase in strength after taping. This trend could possibly be proven through refining the experiment. This experiment may have ended in inconclusive results and could be improved due to any of the following:

1. Too small of a sample size - this experiment had 7 participants and, as with any experimental sample size, more participants could lead to different results and would lead to a more accurate representation of the population.

2. Non-random sample - the participants were selected based on previous ankle injury in the last two years. Opening the experiment to anyone could give a better baseline, or control group, to compare the variable data to.

3. Subjectivity of inclusion tests - the tests that were used as inclusion criteria (anterior drawer test and Talar tilt test) are subjective to the examiner. Both tests are deemed positive or negative by the examiners feel and comparison between ankles, and there is no objective measurement to determine a positive test. Determining a numerical measurement that states whether each orthopedic test is positive or negative would insure consistency of the condition of each participant's ankle.

Although this experiment ended with inconclusive results, certain trends that were observed lead one to believe that minor alterations to the experiment could end in more statistically significant results.

Conclusions

This study concludes that Kinesio® Tape did not have a statistically significant effect on strengthening the ankle joint when testing the ankle muscle strength in plantarflexion, dorsiflexion, internal and external rotation using the Dynamometer. However, Kinesiotaping caused a significant increase in muscle strength in both the injured and non-injured ankles when comparing Pre and Post taped measurements independently to one another. This study offers information that may stimulate new design of ankle taping methods by using different testing strategies and further research may help to reduce uncertainty of the effects of Kinesiotaping on functional performance.

Limitations

With the current data, the study recommends that there needs to be further research done in the field of kinesiology taping. When it came to the tape, subject reported that the tape fell off or lost adhesiveness two days after application. The tape is claimed to stay on for 3 days with athletic activity. This could suggest error in taping or the integrity of the tape is not what the makers of Kinesio® Tape make it out to be. Patient compliance was also a limiting factor, for some subjects did not complete the study by not allowing for post measurement or had voluntarily

removed the tape. The subjects could have skewed their own results by not pressing as hard as they could into the Dynamometer (the device used to measure the strength of muscles surrounding the ankle) The Dynamometer relies on an equal stabilization by the user as the subject presses into the device. There is a chance of error in reading the amount of pressure if this procedure is not done correctly. Participants also could have used the table to brace themselves and make their reading stronger then it really was. Also, there is no research that involves the effects of Kinesio® Tape on muscle strength of a sprained ankle. However there are studies that measured the effects of muscle strength on an uninjured muscle immediately post taping. The studies show that there were no effects of muscle strength post taping. However, there are no studies that measure the strength of a muscle when the tape has been left long enough to allow physiological changes to occur in the muscles. The researchers had full access to the research lab of the college and devices used in the Biofreeze Clinic on Logan College of Chiropractic campus. The sample size used in this study could have been bigger. The scarcity of subjects that had a sprain within the last year to fully comply and put time aside for the study were difficult to obtain. This made it difficult to find significant relationships from the data collected as statistical tests normally require a larger sample size to ensure a representative distribution of the population and to be considered representative of groups of people to whom results will be generalized or transferred. Self reported data from the subjects during their intro questionnaire to see if the subject could participate in the study could have been falsified. The subjects had to have sprained one of their ankles within the previous year to be qualified for the study, which limited the amount of subjects that could be obtained for the study. The lack of previous data or research about Kinesio Tape on sprains also leaves unanswered questions about the study. This indicates that this study could be used as a pilot study used to lay ground work for future research.

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Appendix B
Screening Questionnaire

What is your current age? _____

What is your weight? _____

What is your height? _____
Dr Only: Calculated BMI _____

What is your dominant foot? _____

How long ago did you sprain your ankle? _____

Do you currently have a knee pathology or injury such as a malignancy, infection or fracture?

YES NO

Do you currently have a hip pathology or injury such as above?

YES NO

Do you currently have an ankle pathology or injury excluding the sprain?

YES NO

Appendix C

Ankle assessments:

1. Rule out fracture with the Ottawa ankle rules – Palpate each of the following for tenderness

   a. Posterior tip of Lateral Malleolus
   b. Base of the 5th metatarsal
   c. Navicular
   d. Posterior tip of Medial Malleolus

2. Evaluation/Special Orthopedic Test

a. Anterior Drawer Test* + -
b. Talar Tilt Test** + -
c. Circumferential Measurement of Ankle R _____ L _____
d. Sensory Testing (pinwheel)

L4 L5 S1 S2

e. Visual inspection
   i. Bruising Yes No
   ii. Discoloration Yes No
   iii. Scar Yes No
f. Difficultly bearing weight Yes No
g. Gait examination

*Anterior Drawer Test – Patient (seated) flexes knee 45; examiner attempts to stress the anterior ligaments of the ankle.

**Talar Tilt Test - Patient (seated) flexes knee 45; examiner attempts to invert and evert the foot to stress the lateral and medial ligaments of the ankle.