The Effects of Kinesio Taping on Hamstring Flexibility in Footballers

Declan Goodman

Gwen Dalgleish

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BSc (Hons) Sports Therapy
Declan Goodman

M2067314

BSc Sports Therapy

School of Social Sciences & Law

University of Teesside

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Acknowledgments

First and foremost, I would like to express my sincere gratitude to my supervisor Gwen Dalgleish for the advice and support towards my research. On top of that I would like to thank kinesio UK for supplying the kinesio tape for the research study also the participants who took part for their cooperation in the research and finally I would like to thank my family and friends for giving me the support to complete the study.
Abstract

The purpose of this study was to determine the effects of kinesio tape on hamstring flexibility in footballers. Ten footballers participated in the study. Participants performed an initial baseline measure of an active knee extension test (AKE) and was measured; before application, after application, five minutes after application, twenty-four hours after application and five minutes after the removal of the kinesio tape. The Kinesio tape applied was an ‘I’ strip which ran from the insertion and origin points of the bicep femoris and the semitendinosus. Through the evaluation of the mean scores achieved, hamstring range of motion (ROM) significantly increased 6.9° from before application (46.297°) to five minutes after the removal of kinesio tape (53.197°) F (1.3, 3.763) =11.866; p=0.003; n=5.69. Based on the findings, it is established that kinesio tape applied on the hamstrings had a significant effect on improving AKE scores. Further investigation on the effects of kinesio tape on hamstring flexibility is needed.
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Chapter 1 - Introduction

Kinesio tape is a relatively new concept of taping developed by Dr Kenzo Kase in 1973 and his intention was to construct a tape which could not only support muscles and joints but also aid in range of motion (ROM) and produce benefits to the blood and lymphatic system which would not conform to other tapes. Kinesio tape has an elasticity of 30-40% of its resting length which in turn should allow for a better range of movement. It is made of 100% elastic fibres. There is a wave-like pattern which resembles fingerprints which allows the kinesio tape to breathe. The hamstring muscle group consist of three muscles; bicep femoris, semitendinosus and semimembranosus. All three of these muscles originate from the ischial tuberosity. Bicep femoris runs laterally down the posterior aspect of the upper leg and attaches on the head of the fibula and lateral condyle of the tibia. The semitendinosus and semimembranosus run medially down the posterior aspect of the upper leg and attach medially on the tibia and on the medial condyle of the tibia. The hamstrings flex the knee and extend the hip. Hamstrings play a fundamental role in a copious amount of daily activities ranging from; walking, running, jumping and controlling movements of the trunk. Flexion at the hip has a range of 120°-140° this can be compromised due to the hamstrings being tight. Tightness of the hamstrings could have an effect on the knee, thigh, hip and spine. Possible pathologies in relation to a lack of range of motion consist of muscle strains, patellofemoral dysfunction, ischial tuberosity, tendinitis and lower back pain (Starkey & Ryan 2003). Arnason & Sigurdsson et al (2004) composed a study on the risk factors for injuries in football. After a study of 306 male footballers it was established that hamstring injuries where to be the most common. Footballers that had obtained a hamstring injury on average had a lower degree of flexibility in the hamstrings. De Hoyo & Alvarez et al (2013) looked into the immediate effect of kinesio taping on muscle performance in young football players, it was to be shown that kinesio tape does not produce short-term improvement in muscle performance in young football players. Cross & Worrell (1999) conducted a study on using a
static stretching programme on the hamstrings as they also identified that a lower degree in flexibility heightened the risk of injury. Improving the degree of flexibility in the hamstrings ultimately reduced the amount of musculotendinous strains in the hamstrings in college football players. Power & Behm et al (2004) argued that although static stretching did improve range of motion it reduced maximal voluntary force. O’Sullivan & Murray et al (2009) looked at both static and dynamic stretching on hamstring range of motion and although static stretching resulted in improving flexibility it reduced maximal voluntary force whereas dynamic stretching did not improve on range of motion in the hamstrings. As stretching has their down falls the researcher is looking at an alternative method to improving hamstring flexibility in football players as hamstring injuries were found to be the most common injury and a factor of getting a hamstring injury was due to a lack of range of motion. Improving on hamstring flexibility through the use of kinesio tape could result in a reduction in hamstring injuries. A hypothesis has been set by the researcher that kinesio tape will significantly increase hamstring flexibility in footballers, also with a null hypothesis that kinesio will not significantly increase hamstring flexibility in footballers.

Chapter 2- Literature Review

There are a limited amount of research papers that look into kinesio tape as an effective method to resolve flexibility. Albeit the literature covers a vast amount of theories, this review will target four themes that appear throughout the literature. The first theme consists of: kinesio tape and its performance on flexibility. Secondly the hamstrings muscle group. Thirdly the AKE test and finally the validity and reliability of the goniometer. The literature portraits this in a variety of situations. This study will essentially focus on kinesio tape more specifically tape developed by Dr Kenzo Kase and therefore an exclusion criteria of other variations of kinesio tape is not present in the literature.
2.1 Kinesio Tape Properties

Williams & Whatman et al (2012) looked into kinesio tape as a method of treatment and prevention of sporting injuries. As kinesio tape can be used for a variety of different things, Williams & Whatman et al specifically looked at its role with regards to pain, range of motion (ROM), strength, proprioception and muscle activity. It was also mentioned the properties of kinesio tape being a thin elastic tape that can be stretched up to 120-140% of its resting length and recoils back to its original length when applied. By doing this it allows a greater ROM with the improvement of circulating blood and lymph flow by increasing interstitial space. In saying this, if these properties were to be true kinesio tape would aid in ROM in many studies whereas Williams & Whatman et al disagree and state the amount of studies that provide beneficial effects with regards to ROM are not significant enough and therefore more studies need to be performed to give kinesio tape a stronger case when aiding in ROM.

2.2 Hamstring Pathology

Kujala & Orava et al (1997) researched into hamstring injuries as they are to be the most common muscle strain in athletes and is usually due to sprinting or jumping. The reason for a muscle strain to happen is down to hamstring tightness or a lack of ROM where the force being put through the muscle with regards to an explosive action is too powerful and this is where an injury occurs. It was said that improving ROM could see a significant decrease in hamstring injuries, through the use of kinesio tape and its apparent properties of improving ROM it could be used as a useful tool to aid athletes in the prevention of hamstring injuries. Similarly Opar & Williams et al (2012) also looked into hamstring strain injuries and have found similar findings in that hamstring injuries are found to be the most common injury in various sports; American football (32%), rugby union (21%) and soccer (16%).
agree that a factor associated with hamstring strains is a lack of ROM and improvement of this could prevent injury or re-injury to the hamstrings. Woods & Hawkins *et al* (2003) looked at hamstring but more specifically in professional footballers in England. A questionnaire was filled out by 91 professional football clubs who noted current injury status over two seasons. From the study 87% of the clubs completed the questionnaire and it was found that hamstring injuries accounted for 12% of all injuries with 53% involving the bicep femoris. It was calculated that 15 matches were missed per club per season because of hamstring injuries. Through the use of kinesio tape and its properties of improving ROM it could lower the injury and in turn lower how many matches are missed in a season because of injury.

### 2.3 Kinesio Tape on Flexibility

Yoshida & Kahanov (2007) examined kinesio tape and how it affects trunk flexion, extension and lateral flexion. Through the use of a dependent T-Test and two groups of healthy subjects with an exclusion criteria of a questionnaire in which a failure of any question would exclude them from the study. One group had kinesio tape applied to the lower trunk whereas the other did not have any tape. Measurements of these movements were taken before and after application, in this study it was not stated on the timing of measurements and therefore it cannot be proved nor disproved whether increasing or decreasing time after application for measuring to find any beneficial effects. In saying this, having multiple measurements after application at different time intervals could give a more in depth and accurate findings to present a stronger study. On the other hand, the use of two groups and comparing them between each group portrays a beneficial effect as a comparison can be made between the two groups to show any signs of kinesio tape improving ROM. The researchers also took readings with the use of a tape measure by using this method there will be a significant
amount of human error present (Frost & Sandra et al. 1983). Although it was mentioned that as they only had limited resources that the use of a tape measure was the only method of recording data but they did clarify that using an electromyography and infrared thermography to detect changes in muscle excitability and temperature would be the best method of measuring movement. From their research it was found that kinesio tape applied over the lower trunk did have an increase on lower trunk flexion ROM only. Kinesio tape produced a gain of 17.8cm when compared with the non kinesio tape group. With all things noted, a future study that could be composed to aid with a stronger case would be to use three groups consisting of a kinesio tape group, sham tape group and no tape. Taking more measurements once the tape has been applied would show if the tape increased ROM over a period of time and how long the tape needs to be applied before beneficial effects begin with regards to ROM. Overall this study has a similar relation to the research study being performed in the fact it looks at kinesio tape and its fundamental properties on ROM and as the literature states there was a significant effect to propose that kinesio tape does work in the aiding of improving of ROM. Similarly Thelen & Dauber et al. (2008) studied the efficacy of kinesio tape of shoulder pain by using forty-two subjects who have been diagnosed with a rotator cuff injuries and they got assigned to two groups, a kinesio tape group and a sham group who wore it for two consecutive three day intervals. Self-reported pain scale and ROM were measured. Although there aim was to check if kinesio tape aided in the reduction of pain, what was found was that kinesio tape could potentially be of some assistance to ROM rather than decreasing pain intensity. A limitation of this study was that there was not a third group which consisted of a control group who currently had a rotator cuff injury but received no tape application, which would provide a condition that produces natural injury healing time.

Two studies by Merino-Marban & Fernandez-Rodriquez et al. (2011) and Lumbroso & Ziv et al. (2014) both used kinesio tape as a method for improving ROM but more specifically on the hamstrings. Both studies similarly used the same data analysis procedure by the use of a
repeated measures ANOVA which is the same to that of the research study that is being performed. Both groups used an inclusion and exclusion criteria to recruit participants, in their inclusion criteria they both stated that they are looking for healthy participants but Lumbroso & Ziv et al went on to say that participants with an average or poor score attained on the trunk flexibility test were accepted. With regards to the exclusion criteria Lumbroso & Ziv et al stated that if it was found that the participant was pregnant, had pelvis or lower limb surgery, history of trauma or injury of the hamstrings, hyper-sensitivity, any current treatment or physical therapy that was aimed to improve flexibility then they would be excluded from the study. Merino-Marban & Fernandez-Rodriquez et al had a similar exclusion criteria were if the patient was found to have, suffered any disease that could be aggravated by the study, skeletal muscle limitation, spinal or hip pain that would limit participation or muscular pain at the time of assessment. On the other hand this is where both studies differ, on the methodology. Lumbroso & Ziv et al used eighteen participants and performed the straight leg raise (SLR) as a method of measuring hamstring ROM. The time of measurements were set at; before application, fifteen minutes and forty-eight hours after application. Merino-Marban & Fernandez-Rodriquez et al took a different approach by using forty-three healthy students and had both legs tested under three conditions, kinesio tape, sham tape and control. They used the same technique as in the other study by measuring through the use of SLR. Each leg was measured twice, there was a twelve minute rest period between each set and a one minute break between each repetition. Baltaci & Un et al (2002) looked at a variation of the sit and reach test by having two other modified sit and reach tests (back saver sit and reach and chair sit and reach) and they were then a comparison was made to decipher which was the best method of the sit and reach test, from a total of one hundred and two participants whose inclusion criteria of having no musculoskeletal injuries or lower back pain that could hinder their performance when participating in the three tests. Four physiotherapists took part in measurements of the three tests and a goniometric measurement of hamstring flexibility.
Three measurements were taken throughout all of the test which will give more of a reliable results. From the results, the validity for all three sit and reach tests showed to be similar but it is stated that the back save sit and reach is proven to be the better test as the similar criterion validity and was reported to be the most comfortable but on the other hand it should be taken with caution if lower back is the measurement process. A limitation to Lumbroso & Ziv et al study comes as there was no comparison that could be made with a sham tape to decipher if the kinesio tape did play a fundamental role with regards to improving ROM in the hamstrings whereas in the other study they used a sham tape to see if any differences occurred between the two. Another flaw is that evaluations were not random, therefore at least part of the effect can be attributed to a motor learning of the task. With regards to Merino-Marban & Fernandez-Rodriquez et al a limitation is that the athletes are healthy and therefore assumption can be made that hamstring flexibility was at full ROM which would stipulate that kinesio tape would not improve ROM as participants could already achieve full ROM. Results show that Lumbroso & Ziv et al found no immediate change after application but did find a significant difference on the two day follow up which can be concluded that kinesio tape can be a factor when aiding in ROM on the hamstrings. Merino-Marban & Fernandez-Rodriquez et al also produced similar findings in the study that they performed as they did not show any significant difference in either leg in all three conditions therefore this could suggest that kinesio tape does not improve hamstring ROM initially but as time progresses there is significant improvement of hamstring ROM. To summarise, these two studies display similar relation as to finding out if kinesio tape improves ROM but more specifically hamstrings.

Krohn & Castro et al (2011) ran a similar study to the previous studies as they looked at the effects of kinesio tape on hamstring flexibility. Using a T-Test, forty-five subjects were separated into three groups and hamstring flexibility was then measured through the use of a sit and reach test. One group received an inhibition taping while the other a facilitation and
the third group was a control. Once tape had been applied they were instructed to walk 0.5 miles to make sure that the tape was applied suitably. After the 0.5 miles had been performed a measurement was taken and was then re-measured again twenty-four hours later. Using more times for measurements could show when the kinesio tape becomes beneficial and therefore a guide can be set for application to produce the best results. The results attained showed that kinesio tape demonstrated improvements to their pre-tape measurements but in a comparison to the control group, the data was not significantly different. This could be down to the sit and reach test as it takes into account other muscle groups and not just the hamstrings and therefore results will not solely take into account the hamstring but also other parts of anatomy which will not show how effective the kinesio tape is on hamstrings. Lopez-Minarro & Andujar et al (2007) compared spine posture in various sit and reach test protocols and was found that thoracic and lumbar postures are influenced by position and administration of sit and reach tests. This shows that the use of the sit and reach tests scores are influenced by spine postures and not solely the hamstrings. A conclusion was made that kinesio tape did not make a significant difference in the flexibility of hamstrings. It was mentioned that a future study that could be performed is the use of using a group of participants from the same background and use more testing times which is proposed for the research study. In saying this it was never stated how many times the sit and reach test was performed at during each stage. Performing more than one test at each set would create a mean score and could give a more reliable score rather than just performing one test.

2.4 Outcome measures

Davis & Quinn et al (2008) checked the validity of four clinical tests to measure hamstring flexibility. The tests that were scrutinized were the active knee extension test (AKE), sacral angle (SA), straight leg raise (SLR) and the sit and reach test. By using eighty-one participants, validity was determined through the use of linear regression, correlation and K statistics. From the four techniques, intratester reliability ranged from 0.92-0.95 with AKE
being 0.94. It was found that SA was unable to measure any subject as having tight hamstrings whereas the other three test recorded of subjects having tight hamstrings.

Similarly Gajdosik & Lusin (2015) looked at the reliability of the AKE test to see how good of a technique it was to measure the tightness of hamstrings. They did this by using fifteen participants and used a test re-test on the same day. From the test re-test method the reliability coefficients were 0.99 on both legs. It was said that having high reliability was attained by having body stabilisation, a defined end point of motion and accurate instrument placement. For a concurrent validity both studies achieved similar scores (0.66 and 0.63) when performing the AKE test. A potential limitation for Davis & Quinn *et al* is that they used several testers and therefore using multiple testers would give less reliable results as different experience levels of the testers will give different results. Gajdosik & Lusin (2015) and Davis and Quinn *et al* both agree it is a valid and reliable test when conducted to a high standard and would provide therapists performing research a reliable method in the measurement of hamstring flexibility.

With regards of using a goniometer Gajdosik & Bohannon (1987) reviewed the validity and reliability of the goniometer as a measurement of the extremities, with regards to reliability it was stated that performing measurements with the goniometer at short time intervals (no longer than a day) produced more accurate results than on longer time intervals (days to weeks). With regards to validity it is stated that the goniometer measured around a central point gives ROM measurements a clinically valid option for measurements. Gogia & Braatz *et al* (1987) also looked at reliability and validity of goniometric measurements but more specifically at the knee. The use of a goniometer relates to the study being performed as it is proposed as a measurement for the AKE test. To test the validity and reliability of the goniometer they used two physical therapists and independently measured the same angle of knee. The result showed that the intertester reliability (*r*= .98; ICC = .99) and intertester validity (*r*=.97-.98; ICC=.98-.99) were established as being high and therefore the results of
this study highlights that through the use of a goniometer and performed by a therapist who can identify bony landmarks to create measurement points at the knee joint are both reliable and valid. These two studies by Gajdosik & Bohannon and Gogia & Braatz et al both agree that the goniometer is a reliable and valid source of recording measurements in a clinical practice and Gogia & Braatz state that it’s a valid measurement tool for the knee joint. Although a study by Rome & Cowieson (1996) disagrees as they ran a study using a goniometer, fluid goniometer or an electrogoniometer for recording measurements and they suggest that all three of the measurement tools cannot be used to give a reliable outcome and if strict protocols are not followed in a clinical practice then the measurements taken become invalid. Although it has been disagreed Gogia & Braatz et al provide high intertester reliability and intertester validity towards the use of a goniometer in a clinical practice whereas Rome & Cowieson intertester reliability (0.28-0.98) and intertester validity (0.74-0.98) show a less significant results and therefore Gogia & Braatz provide a stronger case in the favour of goniometric measurements as a useful tool for measuring ROM.

2.5 Psychological Factors

On consideration, kinesio tape could be down to a ‘placebo effect’. A placebo is an object that has no clinical activity which is identical to the active object and cannot be recognised as being a ‘fake’ protocol (Sundararajan 2006). The placebo effect could potentially be one of the most versatile tools that a researcher can use to find out if the object being tested is of any use (Margo 1999).

Vercelli & Sartorio (2012) looked at the psychological side of kinesio tape by producing a study that was a single-blind, placebo controlled crossover trial. It was performed by having subjects being tested across three sessions and receiving two kinesio tape conditions randomly with the aim of enhancing muscle strength. Tests that were performed are as
follows; isokinetic maximal test, the single-leg triple hop and the global rating change scale. The results from this study showed that kinesio tape showed no significant difference with regards to maximal quadriceps strength and was stated that placebo effects on subjective increase of strength perception were observed across all type of kinesio tape applications. Vithoulka & Beneka et al (2012) similarly discovered some placebo effects when researching into kinesio taping on quadriceps strength during isokinetic exercise in healthy non athlete women. When comparing kinesio tape, placebo tape and no tape there appeared to large placebo effect as it was calculated to have a 97% likelihood of the findings being trivial.

2.6 Conclusion

Throughout the studies, it has been established that hamstrings are commonly injured in a wide range of sports and having a lack of ROM plays a part in becoming injured and is found that improving hamstring ROM will see a reduction in the number of hamstring injuries. With regards to kinesio tape, there has been similarities between the results as they show that kinesio tape has a slight effect on flexibility or no effect but all studies agree that further studies are needed to decipher whether kinesio tape is an effective method for hamstring flexibility. All of the studies used participants from different backgrounds whereas using participants from the same background could show better results. Each studies used different techniques to measure hamstring ROM, AKE, SLR and sit and reach. From the studies it was shown that the AKE test would be the best technique to choose as it provides the most valid and reliable results. Using a longer time span with different time intervals for measuring ROM produced better results than taking before and after measurements as it shows when kinesio tape activates and becomes beneficial to the participant. Using three groups that consist of kinesio tape, sham tape and a control group eliminates the chance of a placebo effect as it can be compared to other groups to decipher if kinesio tape does improve ROM. It
is shown that the use of a goniometer can be used as an effective way of taking a measurement in the aid of measuring hamstring ROM at the knee joint.

A research proposal composed after reviewing literature around kinesio tapes effect on flexibility is taking participants from a sport that has a high percentage of hamstring injuries which occur in football and applying tape to the hamstrings and measuring hamstring ROM through the use of the AKE and with the use of a goniometer. Taking measurements at different time intervals of up to a day will show whether it firstly improves ROM but at what time the kinesio tape properties start to improve ROM. There will be an exclusion criteria in which if the participant displays a good ROM then they will be excluded from the study as an improvement will not be needed through the use of kinesio tape.

Chapter 3: Methodology

3.1 Design

Repeated measures ANOVA

3.2 Setting

This study was performed at Teesside University at the school of social sciences and law. Middlesbrough, United Kingdom.

3.3 Subjects

Subjects were recruited through the use of the university football team and they were made aware of the inclusion and exclusion criteria by arranging a meeting before a training session and revealing what was required of them. Contact details were then taken from players who were interested and meeting arrangements were made to suit both cliental and researcher.

3.4 Inclusion Criteria/Exclusion Criteria
The inclusion criteria for subjects have to meet are being male footballers aged between 18 and 30 and has achieved a poor score of the active knee extension test (AKE) (Score below 90\(^\circ\)). Exclusion criteria is that they have a hypersensitivity to tape and if they currently have any injury to the hamstrings, knee or hip or is currently receiving treatment to aid in improving range of motion (ROM).

### 3.5 Procedure

Ten male footballers received an information sheet, consent form and questionnaire to see if they are eligible to take part in the study. Subjects were tested for the inclusion/exclusion criteria by performing the AKE test (AKE) to assure the subject can be included. Once the subjects were found to have an AKE score of <90, a first set of results can be taken prior to the application of kinesio tape. Once applied the AKE test will be applied at different intervals which are as follows; immediately after application, five minutes after application, twenty four hours after and five minutes after the removal of the kinesio tape (Dependent variable is the AKE test and independent variables is the timing intervals and kinesio tape).

### 3.6 Kinesio Tape Application

The application of kinesio tape was performed by a qualified practitioner in the field of kinesio tape. If the subject had a significant amount of body hair, it was advised to the subject that the area was shaved before application of the kinesio tape. When applying kinesio tape to the hamstrings, the tape was applied to the subject from a standing position with the trunk flexed to obtain hip flexion. Kinesio tape was applied using the inhibition method (Kase & Wallis et al 2003) An ‘I’ strip was applied from the head of the fibula and ran along the biceps femoris muscle belly and attached onto the ischial tuberosity. A second ‘I’ strip was applied at the proximal tibia, medial to the tuberosity and ran along the semitendinosus
muscle belly and attached onto the ischial tuberosity. Tension was applied at approximately 25%.

3.7 Active Knee Extension Test (AKE)

To perform the AKE test, the leg being tested is passively lifted to have the hip flexed at a 90° angle and have the knee free flexed. A goniometer lateral to the knee with the stationary hand pointing towards the head of the fibula and rotatory arm pointing towards the greater trochanter. The subject then actively moves the knee to the available range of motion (ROM) which is determined by the subject’s tolerance to the stretch or maximal stretch has been felt by the tester. At the end of ROM the reading of the goniometer is taken and the score is recorded. Throughout the test the AKE test will be performed three times at each time interval and a mean score will be calculated.

3.8 Data Analysis

Analysis of data will be done by attaining the mean score from the AKE tests done at the different time intervals and using SPSS to find out the significance of the study, standard deviation and standard error and creating graphs will show if kinesio tape has any effects on the subjects.

3.9 Confidentiality

All subjects will be kept anonymised throughout the study by the removal of details on the questionnaire and consent form.
Chapter 4 - Results

The researcher had a hypothesis that stated that kinesio tape would have a significant effect on hamstring flexibility. If the p-values acquired were less than 0.05 then the hypothesis can be accepted but if it were to be over 0.05 then it can be rejected and the null hypothesis can be accepted. The repeated measures ANOVA using mean hamstring flexibility data across all levels present a significant main effect regarding kinesio tape on hamstring flexibility $F(1.3, 3.763) = 11.866; p=0.003; n=5.69$. The application of kinesio tape before application (46.297 mean and 11.86690 standard deviation) to (53.197 mean and 13.46726 standard deviation) the following day. AKE scores ($p = 0.003$) significantly increased consistently from before application to the removal of the kinesio tape a day later with a total mean increase of 6.9° from 46.297° to 53.197°. From Fig.1 shows the raw data for mean and standard deviation showing how spread out the numbers are. It shows the raw data from the kinesio tape application, as the margin of error is at 95% confidence interval, it shows the lower and upper bound to give a true mean is most likely to be between those two numbers. Lower and upper bound is roughly twice the standard error ($=\pm$) and the standard error shows how close the sample mean is to the true mean of the overall population.

<table>
<thead>
<tr>
<th>Fig 1</th>
<th>Hamstring Flexibility</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Before Tape</td>
<td>46.297</td>
<td>3.753</td>
<td>37.808</td>
<td>54.786</td>
</tr>
<tr>
<td>Straight After</td>
<td>47.265</td>
<td>3.622</td>
<td>39.071</td>
<td>55.459</td>
</tr>
<tr>
<td>5m After</td>
<td>48.865</td>
<td>3.539</td>
<td>40.860</td>
<td>56.870</td>
</tr>
<tr>
<td>24h After</td>
<td>53.095</td>
<td>4.060</td>
<td>43.911</td>
<td>62.279</td>
</tr>
<tr>
<td>5m After Removal</td>
<td>53.197</td>
<td>4.259</td>
<td>43.563</td>
<td>62.831</td>
</tr>
</tbody>
</table>
Fig 2. Shows the results from kinesio tape application with regards to mean and standard error of kinesio tape on the hamstrings but in bar graph format. The bars represent mean scores achieved by the participants at each stage and the error bars represent standard error.

Fig.3-12 show the individual results from each participants who received kinesio tape. From the graphs it shows that there has been a significant increase in hamstring flexibility.
Chapter 5- Discussion

Results of the study show that kinesio tape has an effect on hamstring flexibility from before application to the removal of kinesio tape a day later (p= <0.05). This produces a significant finding as poor hamstring flexibility has been closely linked to hamstring injuries (Kujala & Orava et al, 1997. Opar & Williams et al, 2012). A theory behind how kinesio tape works on improving range of motion (ROM) is that kinesio tape increases blood and lymph circulation in the area that is taped by eliminating tissue fluid or bleeding beneath the skin by moving the muscle and due to this physiological change it has the potential to facilitate and increase ROM within the muscle (Halseth & McChesney et al, 2004). Using kinesio tape while participating in exercise can encourage lymph flow at better rate (0.0045± 0.00028 without tape, 0.0556± 0.0151 with tape) (Shim & Lee et al, 2003). Tsai & Hung et al (2009) looked into kinesio tape as a method of encouraging the lymphatic system and is stated that as the skin is lifted by convolutions to increase the space between the skin and muscles, the flow of blood and lymph fluid is promoted. By doing this it not only aids in hamstring ROM but could help with the prevention of injury while exercising due to kinesio tape not only be a method of improving ROM but has fundamental properties of dealing with; pain, strength proprioception and muscle activity. With regards to muscle activity it can also play a role in
improving ROM although arguments have been made of what percentage of muscle activity kinesio tape has. Slupik & Dwornik et al (2007) stated that a 54% increase was present in the vastus medialis twenty-four hours after application and after seventy-two hours a 22% mean increase was present. Hsu & Chen et al (2010) also looked at muscle activation but in the lower trapezius. They found a lower amount of muscle activation (14±12%) in saying this they both found a significant increase in muscle activation which has the potential to be a reason as to why kinesio tape improved upon hamstring flexibility. A further study could be performed looking at muscle activation in the hamstrings and how kinesio tape effects muscle activation and comparing it to hamstring ROM.

A second theory is that kinesio tape stimulates the cutaneous mechanoreceptors at the taped area and due to this stimulation effect it may affect ROM (Murray, 2000). It is stated that applying pressure and stretching the skin has the potential to stimulate cutaneous mechanoreceptors and with the sense of stretching it is thought to signal information of joint movement and therefore it might play a role in acknowledging joint movement and positioning which results from stretching the skin at an end of range (Halseth & McChesney et al, 2004).

From the results there was a mean score increase of 6.9° from before application (46.297) to five minutes after the removal of the tape a day later (53.197). In saying this, the biggest change throughout the timing intervals occurred during five minutes after application (48.865) and twenty-four hours later (53.095) producing a difference of 4.23° improvement of ROM in the hamstrings. There was a trend of kinesio tape gradually improving hamstring flexibility until the removal of the tape which showed signs of not continuing improvement. If kinesio tape was to have been left on longer there could have been further improvement of ROM but on the other hand, removing the tape and measuring hamstring flexibility at different time intervals could potentially show a decrease in hamstring flexibility and therefore kinesio tape is proving to be a short term improvement and maintain an acceptable
hamstring ROM will have to be performed differently. The application of the kinesio tape was two ‘I’ strips along the bicep femoris and the semitendinosus muscles. A different technique that could have been used is an X-shaped application similar to that of Merino-Marban & Fernandez-Rodriquez et al (2011). The base of the tape was placed upstretched with the participant in a neutral body position and then functional strips were placed over the muscle belly. In saying this results produced from that study showed no significant effect to the improvement of hamstring flexibility. This could be down to not stretching the muscle, as previously mentioned, a theory to improving flexibility is down to kinesio tape stimulating the cutaneous mechanoreceptors and applying the tape to a stretched muscle will give the muscle a feeling that is on stretch which could improve ROM.

Taking a sport that is notorious for hamstring injuries such as football, it could drastically benefit the reduction of hamstring injuries as they have been closely related to the player having a lower ROM than in an uninjured player. Arnason & Sigurdsson et al (2004) states that hamstring injuries accounted for 24.2% of injuries during a season in two of the top divisions of football. Hamstring injuries obtained a score which was 8.6% higher than the nearest injury (Knee 15.6%). It was shown that the players who received a hamstring injury had an approximately $3^0$ lower hamstring flexibility than a player who had not received a hamstring injury ($116.6 \pm 3.7$ and $113.3 \pm 0.6$). As the study performed achieved an improvement of $6.9^0$ it could give players with a lower ROM a decrease in the likelihood of injuring their hamstrings. The tape could be applied to players who have a significantly lower hamstring flexibility the night before a game which would improve the hamstrings ROM and in turn lower the percentage rate of a hamstring injury occurring.

Using kinesio tape as a method for improving hamstring ROM and measuring them at different time intervals replicates a study conducted by Krohn & Castro et al (2011) which a structure for the research performed was based upon. In saying this the study differs as the research performed uses participants from a similar background who have a high injury rate
for hamstring injuries to see what effect it has. Also using an AKE test rather than a sit and reach will provide a more reliable and valid score of measurements as it only takes into account hamstring movement whereas the sit & reach take into account lumbar movement (Davis & Quinn et al, 2008. Gajdosik & Lusin, 2015).

A study that found similar findings was that of Lumbroso & Ziv et al (2013) as they stated that kinesio tape improved hamstring flexibility when compared to before application and two days after application, other similar findings is that kinesio tape did not improve flexibility straight away and only had a real effect the day later or in Lumbroso & Ziv’s case, two days later. The results showed that hamstring ROM increased 4.7° which is similar to that of the study performed as a score 6.9° was achieved, in saying this Lumbroso & Ziv et al improvement was attained after two days of measurements and therefore it could be said that after a day, kinesio tape would not significantly aid any further improvements with regards to hamstring ROM but could maintain the improved ROM until the removal of the tape.

Although the kinesio tape applied was on a different area, Yoshida & Kahanov (2007) also reported in finding improvements in improvements of flexibility but more specifically lower trunk flexibility with a 17.8cm difference.

On the other hand, Merino-Marban & Fernandez-Rodriquez (2011) and Krohn & Castro et al (2011) disagree with the other findings and the research study performed as they state that kinesio tape did not have any significant effect on hamstring ROM. In saying this, Merino-Marban & Fernandez-Rodriquez et al only performed one measurement after application which was relatively close to when the tape was applied which would match the studies mentioned earlier that they also had no real improvement but did at a further time interval, if they were to have performed a measurement at a later date they could have also found kinesio tape to be of improvement to hamstring flexibility. With regards to Krohn & Castro et al (2011) although the research study relates closely to this study they both come across with different results as Krohn & Castro et al relates to Merino-Marban & Fernandez-Rodriquez in
saying that kinesio tape does not have any significant effect on hamstring flexibility but said it could not be ruled out as a method of improving ROM as the results were not significant enough.

5.1 Limitations

During this study a few limitations arose. First a control group or a sham taping group was not used and therefore a comparison could not be used between groups to show if kinesio tape effect was producing the hamstring to achieve a better AKE scores when applied. Using a sham group it can rule out a ‘placebo’ effect where a participant might think that the tape is improving hamstring flexibility. Beecher (1995) showed that the placebo effect had a response of 35% which could state that the study used may have some placebo effects from the participants. Using a control group will give a baseline measurements that can be measured within the other two groups to give a stronger study to say kinesio tape significantly improves ROM. Another factor that contributed to being a limitation was that it was not the football season and therefore it was hard to recruit university footballers as there were less players participating in training to arrange meetings for. With regards to arranging meetings it was hard finding university students that would be available for two consecutive days which suited both researcher and participant which in turn took the research longer than anticipated. Once the participants have had kinesio tape applied and awaited to be measured the following day, the participants will vary in activity levels during that time frame and therefore it could influence the hamstring flexibility. Another factor that could influence hamstring flexibility is the diet the participants had, if on the first day of testing the participant had a low calorific intake and then on the second day of testing a high calorific intake then hamstring flexibility could be effected (Smith & Williamson et al, 1997). Tension that was applied was a rough estimate of 25% of its max length rather than having a precise
percentage every time which would bring inconsistencies of tension on the kinesio tape that has been applied to the participants. Due to the limited resources a goniometer was used as the measurement tool to produce hamstring flexibility scores. In saying this it has been said that a goniometer produces a reliable and valid test if the researcher using it is of an experienced standard. The researcher is of limited experience and therefore results will be less reliable than if an experienced research were to perform the measurements. Even though a goniometer is stated by have a high reliability and validity with an experienced tester (Gogia & Braatz et al 1987, Rome & Cowieson 1996). An accurate way of measuring muscle movement is by using electromyography (EMG) as it produces more accurate readings than a goniometer (Nilsson & Thorstensson et al, 1985).

5.2 Future Studies

A future study that could produce a greater depth of information may have been obtained by having three groups consisting of kinesio tape, sham and a control group, by doing this it can be compared on how beneficial kinesio tape is when compared to other groups. Using a better method of measuring hamstring flexibility such as an EMG can produce a stronger validity than the use of a goniometer. Adding more time intervals to see when kinesio tape stops being beneficial when improving hamstring ROM which will then show when the best time to apply kinesio tape to the hamstrings prior to a sporting event. Once kinesio tape has been removed it would be interesting to see if hamstring ROM decreases over time once kinesio tape has been removed or if hamstrings flexibility remains in the same state.
Chapter 6- Conclusion

Throughout this study it has been used to answer the question ‘does kinesio tape improve hamstring flexibility in footballers?’ it has been concluded that kinesio tape did have a significant effect on hamstring flexibility in footballers and by applying kinesio tape it could decrease hamstring ROM as it has been highlighted that hamstring injuries are to be the most common injury in football and one of the reasons is due to poor flexibility and by improving ROM a significant decrease of the injury could occur. Kinesio tape could be used as a ‘quick fix’ method to footballers who need to improve ROM and therefore will give them confidence that improving ROM will decrease the risk of injury and in till will allow them to be able to compete in a game. It has been identified that applying kinesio tape a day before it is needed it would show the most beneficial effects as there was the biggest increase in hamstring ROM during that time frame. An initial hypothesis was set that kinesio tape would have a significant effect on hamstring flexibility in footballers. From the study the hypothesis can be accepted and the null hypothesis can be rejected.
Chapter 7 - References


Chapter 8 – Appendices
Information Sheet

The aim of this study is to determine if kinesio tape has is an effective method on hamstring flexibility in footballers as hamstring injuries is the most common injury in football and has been closely linked with a lack of range of movement in the hamstrings. If kinesio taping was to be found successful in improving hamstring flexibility it could be used as a method of prevention of an injury.

Your role in this study

- Participants will have an initial test measuring hamstring flexibility.

- Once the first test has been recorded kinesio taping will be applied to both hamstrings and a further test will be taken.

- Participants are then required to perform a 5 minute steady warm up to warm up the muscle and then a third test will be done.

- A 24 hour follow up will then be done to see if any improvement has been made on hamstring flexibility.

- A final test will be 5 minutes after the removal of the kinesio tape.

- All result will be gathered and record to see what findings are obtained.

What to find?

Once all participants have completed the study, a predicament has been made that hamstring flexibility will improve throughout the study.

Contact Details

Phone Number: 07749614248

Email: M2067314@live.tees.ac.uk
CONFIDENTIAL MEDICAL QUESTIONNAIRE

All information will be treated as confidential and only members of staff employed by the Teesside University, Sport and Exercise section, will have access.

NAME: .......................................................... D.O.B. ...........................................

1. How would you describe your present level of physical activity?
   Sedentary / Moderately active / Highly active

2. Have you had to consult your Doctor within the last six months?
   Yes □ No □
   (If Yes, please state reason overleaf)

3. How would you describe your present level of fitness?
   Very unfit / Moderately Fit / Very fit

4. How would you describe your present body weight?
   Underweight / ideal weight / overweight

5. Do you smoke?
   Yes □ No □

6. Are you currently taking any form of medication?
   Yes □ No □
   (If Yes, please list all medications/doses overleaf)

If you tick ‘Yes’ for any of the following questions please provide more details overleaf

7. Do you, or have you ever, suffered from diabetes?
   Yes □ No □

8. Do you, or have you ever, suffered from asthma?
   Yes □ No □

9. Do you, or have you ever, suffered from bronchitis?
   Yes □ No □

10. Do you, or have you ever, suffered from any form of heart complaint?
    Yes □ No □

11. Is there a history of heart disease in your family?
    Yes □ No □

12. Do you currently have any form of muscle, ligament or joint injury?
    Yes □ No □

13. Do you, or have you ever, suffered from epilepsy?
    Yes □ No □

14. Do you, or have you ever, suffered any form of illness or injury to the head?
    Yes □ No □

15. Finally, is there anything to your knowledge that may prevent you from successfully completing the practical activities that have been outlined to you in the module practical handbook.
    If yes, please detail information overleaf.
    Yes □ No □
REASON FOR VISIT TO DOCTOR

MEDICATIONS

DETAILS OF MEDICAL CONDITIONS

ANY OTHER MEDICAL INFORMATION

PARENT/GUARDIAN
SIGNATURE (participant) .................................................. DATE ............

SIGNATURE (staff) ............................................................... DATE ............
INFORMED CONSENT FORM

This information will be treated as confidential and only members of staff employed by the University of Teesside, Sport and Exercise section, will have access.

NAME________________________________________ D.O.B. ______________________

MODULE The Effects Of Kinesio Taping On Hamstring Flexibility In Footballers

DATES October- March

1. I confirm that:
   • I am willing to take part in the above research project as a volunteer participant.
   • I have had no significant illness since my last medical examination.

2. I understand that:
   • The researcher will explain the nature and purpose of each data collection session and will inform me of any foreseeable risk to my health as a result of my participation.
   • I understand that I am free to withdraw from the study at any time without the need to give reason.
   • I agree to terminate any practical activity if the researcher in charge feels it is advisable to do so.
   • I agree that my data may be stored and used for the purpose of publication of the study.
   • I understand that in accordance with the 1998 Data Protection Act my data will be anonymised and stored securely.

3. I authorise the researcher in charge to inform my general practitioner should he/she feel that any significant untoward event occurs during or after the practical session, which might be a result of my participation.

__________________________________________________________
SIGNATURE (Student) _______________________________ DATE ____________

__________________________________________________________
SIGNATURE (Staff) _______________________________ DATE ____________
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