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EFFECT OF KINESIO TAPE ON THE LEG POWER OF CHEERLEADERS

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ABSTRACT

Kinesio tape is popularly used by athletes of this generation believing that it can improve range of motion by increasing blood circulation, relief of muscle spasms and correction of misaligned joints (Martinez-Gramage et al. 2014), provide pain relief (Schiffer et al., 2015), prevent injuries and enhance athletic performance (Vinken, 2015). Although these claims have not been strongly validated, the use of kinesio tape is becoming a trend in the field of sports, rehabilitation and orthopedics (Huang et al. 2011). Hence, more research is needed to examine its effectiveness. This research tested the effect of kinesio tape in the vertical jump performance of healthy and injury free cheerleaders using a quasi-experimental design. Fifteen cheerleaders from a public university performed Sargeant's vertical jump test, where subjects jump as high as possible to measure their lower limb power. Five experimental conditions were tested. These experimental conditions were, subjects jumps with; 1. no tape, 2. kinesio tape application in rectus femoris, 3. kinesio tape application in biceps femoris, 4. kinesio tape application in triceps surae and 5. kinesio tape application in gluteus maximus. A facilitative type of kinesio tape application was done in all of the sites tested. Friedman test was used to test significance of the data gathered, Wilcoxon signed rank test and Bonferonni correction was also used to further sieve the results of the data. All of the sites generally increased except for gluteus maximus and only rectus femoris (p =0.002) garnered a statistically significant result. These led the researcher to conclude that kinesio tape has a significant effect on the vertical jump performance of cheerleaders and that rectus femoris (p =0.002) is the best site of application when vertical jump enhancement is desired.
Keywords: *Kinesio tape, vertical jump, cheerleading.*

1. INTRODUCTION

Muscular power is the capability of the neuromuscular system to make a single maximum voluntary contraction at utmost speed (Mostert-Wentzel, Sihlali, Swart, Cillier, Clarje, Maritz, …. & Steenkamp, 2012). It is an important factor when it comes to high intensity athletic performance (Hoffman, 2012). Cheerleading is one of the sports that involves high intensity movements. It is a competitive sport that involves executing gymnastics and stunting skills such as backhand-spring and back tuck, forming of pyramids and executing partner stunts like toss to hands stunts, elevator and throwing a person up high in the air to perform acrobatic skills (Mueller, 2009). In addition, cheerleaders are also required to perform various jumps such as straddle, toe touch, and pike jumps which require the same explosive power that a gymnast must possess (Chappell, 2005; Carrier & McKay, 2006; Bagnulo, 2012). Vertical jump is one valid measure of explosive power, particularly leg power. A high vertical jump leads to successful athletic performance and reflects an athlete's ability to perform various skills (Akl, 2013). It is influenced by many factors such as gender, mus-cle composition and use of arms (Walsh, Bohm, Butterfield, & Jabakar, 2007). Studies show that men perform higher vertical jumps because men have larger muscle fibers and

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higher amounts of fast-twitch fibers than women (Alegre, Lara, Elvira, & Aguado, 2009). One type of vertical jump is countermovement jump. Performing a countermovement jump involves several muscles including the hamstrings, gluteus maximus, rectus femoris, gas-trocnemius and soleus (Bobbert, & Zandwijk, 1999; Nunes, De Noroha, Cunha, Ruschel, & Borges, 2013).

Improving and maximizing an athletes' capability of producing maximal muscular power is essential in most sports (Cronin & Hansen, 2005). One popular mechanical ergo-genic aid used today is Kinesiotape (Drouin, 2013). Dr. Kenso Kase, the inventor of kinesio tape, suggests the following beneficial effects of this elastic enhancement material i) Improve range of motion (ROM) in cases of injury or restricted muscle functioning due to overuse by increasing blood circulation or through stimulation of cutaneous mechanoreceptors (Gramage-Martinez, Merinoramirez, Amer-Cuenca, & Lison, 2014). ii) Decrease the nociceptive input of skin, joints and skeletal muscles by means of sensory stimulation of the skin that results to pain relief. (Schiffer, Mollinger, Sperlich, & Memmert, 2013). iii) Inhibit recruitment of motor muscle units which can cause relief of muscle spasms and correction of misaligned joints (Martinez-Gramage *et al.*, 2014), and lastly, iv) prevent injuries and enhance athletic performance (Vinken, 2014). Although these claims have not been strongly validated, the use of kinesio tape is becoming more popular and becoming a trend in the field of sports, rehabilitation and orthopedics (Huang, Hsieh, Lu, & Su, 2011).

Researchers hypothesize that through application of kinesio tape in the muscle, explosive power can improve through increased activation of the sensorimotor reflex pathways. Huang *et al.* (2011) discovered positive effects of kinesio tape using force plate platform. They measured its effect in the vertical ground reaction force of their subjects and found out that applying kinesio tape in triceps surae increase vertical ground reaction force that manifest increased muscle activation. This was supported by the research of Vithoulka, Beneka, Malliou, Aggelousis, Karatsolis and Diamantopoulos (2010) who revealed that the strength of quadriceps femoris muscle at a maximum eccentric isokinetic exercise increased when kinesio tape was applied in the quadriceps femoris of healthy female subjects. In addition, Slupik, Dwornik, Bialoszewski and Zych (2007) also found positive results regarding the application of kinesio tape in rectus femoris, vastus lateralis, and vastus medialis. Furthermore, Mostert-Wentzel *et al.* (2012) revealed that applying kinesio tape in the gluteus maximus muscle of young healthy male athletes significantly increase shortterm vertical jump height.

On the other hand, several studies reported unfavorable results of kinesio tape in the vertical jump performance of their subjects. Studies of Lee, Chang, Chang, and Chen (2012), Kummel, Mauz, Blab, and Vieten (2011), and Chang, Chou, Lin, Lin, and Wang (2010) compared the results of muscle contraction and activation when kinesio tape is not applied, when placebo tape is applied and when kinesio tape is properly applied. Results of the studies suggest that the application of kinesio tape has no significant effect on muscle contractions and no noted difference between the effects of using placebo tape, kinesio tape and properly applied kinesio tape.

In the study of Vinken (2015) on the effect of kinesio tape in the jumping performance of gymnasts, kinesio tape was applied on the rectus femoris and triceps surae with consideration that these muscles influence the subjects' jumping performance. Subjects performed drop jumps, squat jumps and counter movement jumps. Results of the study revealed that when elastic tape was applied in triceps surae, flight duration during drop jump decreased. Furthermore, when kinesio tape was applied on rectus femoris, flight duration decreased during counter movement jump. These results led Vinken to a conclusion that kinesio tape had no significant effect on the gymnast's jumping performance thus rendering the use of the tape unnecessary. In another study, Nunes *et al.*, (2013) tried to compare vertical jumps, horizontal jumps and the dynamic balance of different athletes' playing different sports. They found out that applying kinesio tape in triceps surae does not improve sports-related movement and therefore should not be considered by

athletes if they want to improve their jumping and balance performance. Lastly, the study of Schiffer *et al.*, (2015) who used healthy uninjured elite athletes also added unfavorable results on the use of kinesio tape. The subject performed double one-legged jump test to measure the effect of kinesio tape in the athlete's jumping performance. The study revealed that kinesio tape application does not enhance elite female athletes' jumping performance.

Kinesio tape, while already popularly used by athletes, has not yet been proven to yield significant effects on an athlete's performance. A research synthesis done by Drouin, McAlpine, Primak and Kissel (2013) confirmed this situation since the studies that they have gathered have different results regarding its effects on muscle activation and performance enhancement. Further research and studies should be conducted to validate its effects on athletic performance and to clarify whether kinesio tape serves its purpose or not.

2. METHODS AND MATERIALS

2.1 Participants

Fifty-two student-athletes belonging to a mixed-gender sport team of a large public university in Metro Manila participated in this study. They have been in the sport of cheerleading for an average or 4.26 years (*SD* = 2.30) and have been training with their current coach for 2.32 years (*SD* = 1.47). Thirty-three (66%) of these student-athletes have competed at least once in an international competition. Among the 52 subjects, only fifteen (*n* = 15; 10 [67%] females; 5 [33%] males) did not have any lower limb injuries for the past 6 months, which qualifies them as subjects of this study. Their age ranged from 16 to 22 years with an average of 18.94 (*SD* = 1.71). Males were taller and heavier than females. Male athletes in this sample stand on average 1.73 m tall and weigh 72.38 kg, while females stand on average 1.37 m and weigh 47.78 kg (*SD* = 9.73). These student-athletes train 5 times a week with 4-6 hours per session. The participants have been in the sport for more than 2 years and have not incurred any lower limb injury such as sprains, strains, fracture and other major injuries for the past six months are eligible to participate in the study.

2.1 Instruments of the Study

Kinesio tape, a waterproof, porous and adhesive tape with a width of 5 cm and thickness of 0.55 cm was used for this study and was applied in the triceps surae, biceps femoris, rectus femoris and gluteus maximus.

To measure the lower limb power of the subjects, *Sargent's Vertical Jump Test was used.* This test has a 0.78 validity correlation coefficient and 0.93-0.98 reliability (Wiggins-James, 2008). To get the measurement, the subject puts chalk on the middle finger of the dominant hand. Standing with the dominant shoulder adjacent to the wall, the subject reaches as high as possible and puts a mark on the wall with the dominant hand (M1). Using a countermovement jump, the subject jumps as high as possible and makes a second mark with the chalk on his/her finger on the wall to know the height of the maximal jump (M2). Distance between M1 and M2 is measured - Maximal jump reach (M2) minus Reach height (M1). The subject repeats the test three times and the best of the three trials is recorded (Miller, 2012).

2.2 Procedure of the Study

A letter of permission was given to the varsity director and head coach of the chosen team one week before the start of the study. The study was conducted on three separate days. On the first session, before the baseline testing was done, consent forms were given to the participants. They

were oriented on the process and objectives of the study to prevent any confusion that may affect the quality of data. Since the researcher is the assistant coach of the subjects, two assistants were trained to facilitate the test to prevent expectation effect. Height and weight were measured after briefing the participants. A five-minute warmup and dynamic stretches were given to the subjects after getting the height and weight of the subjects. Dynamic movements were chosen since studies have linked static stretching to a decrease in performance when the vertical jump test is done 15 minutes after performing static stretching (Bradley, 2007)

Two (2) minutes rest was given after the warm up. Afterwards, three practice trials of the counter movement jump were given to familiarize the participant with the task. Baseline testing was conducted after the practice jumps. Participants were asked to do the Sargent's Vertical jump test where they were asked to perform a counter movement jump 3 times, with 10-15 seconds interval without any tape applied to their body. Subjects were encouraged to jump as high as possible. All the measurements were conducted by the trained assistants.

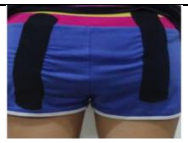
After the first session, a 3-day rest before post testing was given to the participants to avoid fatigue and a learning effect. Post testing was conducted in the second and third session. All of the participants received four kinesio taping applications, each on four different muscle sites namely rectus femoris, triceps surae, biceps femoris and gluteus maximus. All kinesio tape application procedures were conducted by a licensed physical therapist with a certification in kinesio tape application in order to warrant consistency throughout the study. Fifteen minutes after the application of kinesio tape, same set of warm-up, stretching, testing procedure, and number of jumps were done by the subjects. Since fatigue is not a factor in the study, time interval between performance of Sargent's jump test with different tape application was arbitrary.

2.3 Tape Application

A facilitative type of taping was applied to the subjects to stimulate weak and underused muscle. This type of taping is the application of kinesio tape from a muscle's origin to insertion with a 50%-70% stretch (Kase *et al.*, 2003; Kumbrik, 2012). The manner of taping used were based on the instructions given by Borras (2011). Table 1 below summarizes the taping application per site.

Table 1: Taping application in each muscle site

Muscle site	Taping application	Picture
Rectus Femoris Muscle	The left and right rectus femoris muscle was taped from origin to insertion using a I-shaped kinesio tape.	
Triceps Surae Muscle	The left and right triceps surae muscle was taped from origin to insertion using an I-shaped kinesio tape. Another I-shaped kinesi tape was applied horizontally in the medial part of triceps surae muscle.	
Biceps Femoris Muscle	The left and right biceps femoris muscle was taped from origin to insertion using an I-shaped kinesio tape.	

Gluteus Maximus Muscle	The left and right gluteus maximus muscle was taped from ischial tuberosity to posterior superior iliac spine (PSIS) using an I-shaped kinesio tape.	

2.4 Analysis of Data

Data was encoded using standard statistical software. The mean and standard deviation for pretest and posttest vertical jump performances were computed for each treatment group. Univariate normality of data was determined by examining skewness and kurtosis values, Kolmogorov-Smirnov test, and the Normal Q-Q plots. Although the data sample is normally distributed, non-parametric methods were used to test the research hypotheses due to the small population size. As a result, Friedman test was used to compare vertical jump performances before and after the kinesio tape was applied. The difference of the means was calculated per group to determine the impact of kinesio tape in the vertical jump. To examine statistical difference in the mean change per group, Wilcoxon Signed Rank Test was performed while Bonferonni correction test was used to further filter the results of the study. Alpha was set at 0.05 level of significance.

3. RESULTS

The purpose of this study was to investigate the effect of kinesio tape on the vertical jump of healthy and injury-free cheerleaders.

Figure 1: Pre and posttest differences of (4) muscle sites

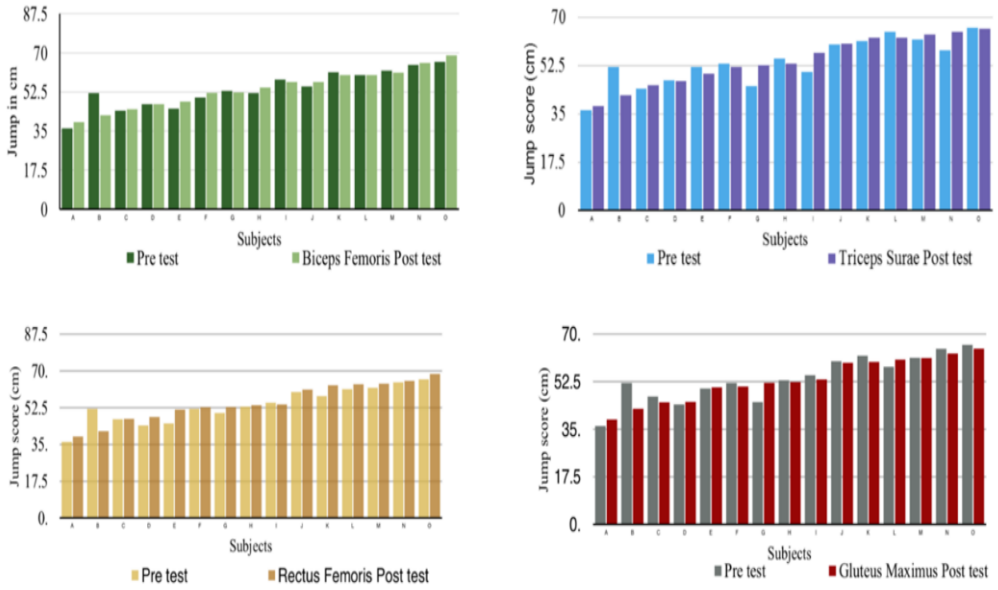


Figure 1 shows the effect of kinesio tape application in the four (4) different muscle sites of each individual subject–whether there was an increase, decrease, or no change in the subject's vertical jump performance. Kinesio tape application in the biceps femoris (z=-1.957, p=0.050) resulted to

an improvement in the vertical jump performance of 8 out of 15 subjects (53%) while 5 subjects (33%) had a decreased performance and the remaining 2 subjects (13%) had no change in performance. For rectus femoris (z=-3.070, p=0.002), 13 out of 15 subjects (87%) had an increased vertical jump performance leaving only 2 subjects (13%) with a decreased performance. Results for triceps surae (z=-1.051, p=0.293) showed 8 subjects (53%) with improved performance while 7 subjects (47%) showed decreased/lower performance. Lastly, Kinesio tape application on the gluteus maximus (z=-0.170, p=0.865) resulted to 5 subjects (33%) showing an improvement in performance while the remaining 10 subjects (67%) had decreased performance. Based on these results, kinesio tape application on the rectus femoris showed the greatest increase in the subjects' jump performance while kinesio tape application on the gluteus maximus had the least effect.

Data was further analyzed in table 2. Friedman test was performed to compare pretest and posttest mean scores of vertical jump in the sample. The results show that there is a significant difference in the scores between two test points X^2 (df) = 12.886, p = .012. Wilcoxon Signed Rank Test was used to compare pretest and posttest scores of vertical jump performance in each muscle site - biceps femoris, triceps surae, rectus femoris, and gluteus maximus. Significant results were obtained in rectus femoris (z=-3.070, p=0.002). On the other hand, no significant results were obtained in biceps femoris (z=-1.957, p=0.050), triceps surae (z=-1.051, p=0.293), and gluteus maximus (z=-0.170, p=0.865). Having these results means there is no significant difference in the leg power results between different muscle sites of kinesio tape application. This indicates that among the lower limb muscles involved in vertical jump, rectus femoris is the best site for application of kinesio tape to help enhance vertical jump performance.

Table 2: Test for significance of jump height for each muscle site

Muscle site	n	Pretest Mean	Posttest Mean	Pretest SD	Posttest SD	*z* value	*p* value
Biceps femoris	15	53.01	53.95	9.0	8.61	-1.957	0.050
Rectus femoris	15	53.01	55.08	9.0	9.00	-3.070	0.002*
Triceps surae	15	53.01	54.35	9.0	8.92	-1.051	0.293
Gluteus maximus	15	53.01	53.25	9.0	8.05	-0.170	0.865

*Significant at p= 0.05

Table 3: Test for significance of jump height scores based on gender

Muscle site	n	Pretest Mean	Posttest Mean	Pretest SD	Posttest SD	*z* value	*p* value
Male							
Biceps femoris	5	62.38	62.50	3.6	4.72	-0.135	0.893
Rectus femoris	5	62.38	62.51	3.6	2.178	-2.023	0.043*
Triceps surae	5	62.38	62.52	3.6	1.40	-0.674	0.500
Gluteus maximus	5	62.38	61.84	3.6	1.96	.767	.913
Female							
Biceps femoris	10	49.42	49.68	6.8	6.67	-2.313	0.021*
Rectus femoris	10	49.42	50.14	6.8	6.53	-2.295	0.022*
Triceps surae	10	49.42	49.61	6.8	6.93	-0.714	-0.714
Gluteus maximus	10	49.42	48.95	6.8	6.12	-.099	.687

*Significant at p= 0.05

Pretest and posttest scores of male and female subjects were also analyzed using Wilcoxon Signed Rank Test. Table 3 reports the values gathered from the test. Based on alpha level .05, males have marginal difference in the results between two test points in rectus femoris (z = -2.023, p = 0.43). Marginal difference was also obtained from two test points of females in biceps femoris (z = -2.313, p = 0.021) and rectus femoris (z = -2.295, p = 0.022).

4. DISCUSSION

The main muscles that work in a vertical jump are rectus femoris and triceps surae. Consequently, based on the data gathered, it was found that kinesio tape has an effect on the vertical jump performance of cheerleaders most especially when applied to the rectus femoris. These muscles also gained the highest mean score in this study. Results suggests that the amount of change in jump height is relative to the muscles that work for a certain type of movement. Hence, other muscles will generally have lower scores compared to the main muscles used for countermovement jump (Vinken, 2015). Positive results in of the study also validates the study of Vithoulka (2010), Slupik (2001) and Huang (2011) who hypothesize that kinesio tape when given tension provides a pulling force that results to a change in stretch load, shear force and pressure that triggers the mechanoreceptors in the subnormal soft tissue and fascia that leads to increased muscle contraction.

Jump height results varied in each site were also different from each subject. Different factors such as the amount of pre-stretch initiated at the muscles during the jump test, the muscles activated, and the type of taping procedure may have affected the results. Vinken (2015) reported that facilitative taping was one of the reasons why the subjects did not obtain significant change in their jump height. In this study the amount of pre-stretch may have probably affected the jump performance of some of the subjects since it was observed that they swung their arms and bent their knees fast. According to McBride *et al.* (2008), to obtain optimal jumping performance, pre-stretch should be done slowly and should have a relatively low average of force. The facilitative type of taping used could also have hindered the amount of stretch and muscle activation in some of the muscle sites. In contrast to the results of the study of Vinken (2015), kinesio tape showed a statistically significant effect in the vertical jump of the subjects when applied to the rectus femoris. This could be due using different test, Vinken (2015) used electronic platform while the current study used Sargent's vertical jump test to measure power.

Results of the study were also different to Mostert-Wentzel (2012), who found out that applying kinesio tape in the gluteus maximus had a significant effect in vertical jump. The application of kinesio tape in the gluteus maximus generally led to a lower jump performance of the subjects. Perhaps, this is due to the different technique of taping used in this study. In the research of Mostert-Wentzel (2012), the taping techniques used were Y-strip and I-Strip, which were applied horizontally. In the current study, an I-strip was applied vertically in both sides of the gluteus maximus, which limited the amount of pre-stretch of gluteus maximus during the eccentric phase of the jump and may have caused the decline in the vertical jump scores of the subjects.

Another factor that might have affected the results of the study is the amount of time that kinesio tape was used. Some studies suggest that application of kinesio tape in a longer duration can cause greater muscle activation (Slupik *et al.*, 2001). In this research, vertical jump was performed after 15 minutes of application which could have led to a small increase of improvement in the subject's vertical jump based on the idea of Slupik *et al.* (2001). The amount of time required for kinesio tape to take effect is still unknown, hence future research can investigate how long kinesio tape should be used to gain beneficial and better results.

The main limitation of this study is the sample size. The sample was very small, due to the number of injured members of the cheerleading squad. This problem may be remedied by conducting the study during a different time - when training is less rigorous and there is a smaller incidence of injuries. The inclusion of uninjured players may be warranted to increase sample size, and the effects of injury may be canceled out because it is not the actual jump height, but the difference in jump height, that is being investigated.

5. CONCLUSION

Based on the results obtained from the study it is concluded that- application of kinesio tape on the rectus femoris results in a significant improvement in vertical jump performance of cheerleaders. Kinesio tape application on the gluteus maximus, biceps femoris, and triceps surae does not yield a favorable change in vertical jump performance. Furthermore, it is also concluded that kinesio tape is a good ergogenic aid for vertical jump when used in and applied correctly to the rectus femoris.

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