THE BIOMECHANICAL EFFECTS OF ROTATOR CUFF TAPING ON MUSCLE ACTIVATION AND THROWING VELOCITY IN BASEBALL PLAYERS

Kara-Lyn Harrison[1], Carlos Zerpa[1], and Paolo Sanzo[1]

School of Kinesiology, Lakehead University, Thunder Bay, Canada[1]

The purpose of this pilot study was to investigate the effect of taping (Kinesio tape, placebo tape, no tape) on the velocity of an overhead baseball throw and muscle activity using surface electromyography (EMG) and a radar gun in a population of baseball players. Participants (n=13) completed three maximal overhead throws while surface EMG and velocity of overhead throws was recorded. There was a statistically significant two-way interaction between tape and muscle type, $F(6,66) = 2.656$, $p < .05$. There was no statistically significant difference in throwing velocity with the application of the different taping conditions.

KEYWORDS: tape, baseball, electromyography

INTRODUCTION: Baseball has become increasingly popular in recent years, with 25 million participants in 2017 (Sports & Fitness Industry Association, 2017). An overhead throw is described as an intricate and highly coordinated musculoskeletal sequence (Chalmers et al., 2017). Chalmers et al. (2017) described an overhead throw or pitch in baseball, as one of the fastest known human motions. Unfortunately, baseball has been also estimated to account for greater than 50,000 injuries per year (Cools, Witvrouw, Danneels, & Cambier, 2002).

The muscles that play a major role in producing the overhead baseball throw are the pectoralis major, supraspinatus, infraspinatus, and teres minor muscles (Erickson et al., 2016). The supraspinatus muscle is the rotator cuff muscle that is most likely to be injured during an overhead throw and is at high risk of injury during the deceleration phase (Erickson et al., 2016). Kinesio tape has been hypothesized to change muscle activity and decrease the risk of injury (Kase et al., 2013, Ujino, Eberman, Kahanov, Renner, & Demchak, 2013).

Kinesio tape has been hypothesized to affect muscle facilitation by modifying the activation levels of the muscles underlying the tape and by increasing the strength of weakened muscles (Kase et al., 2013). In baseball, the precise motor acquisition and muscle activation pattern is important in optimizing the performance of the overhead throw but also in preventing injuries to the shoulder joint (Bruan et al., 2009). Alterations in muscle activation patterns in the muscles of the rotator cuff may predispose a baseball player an increased risk of injury (Bruan et al., 2009). The research relating to muscle activation changes with the use of Kinesio tape remains controversial, with many studies having contradictory and confounding results. Some studies have found that Kinesio tape has had little to no affect in muscle activation level (Janwantanakul & Gaogasigam, 2005; Zanca et al., 2016). While others have reported that Kinesio tape has had a significant effect when evaluating muscle activation levels in different segments of the body (Slupik et al., 2007, Vithoulka et al., 2010).

Due to contradictory hypothesized effects of Kinesio tape, more research is needed in order to discover if it the application of tape does have an effect on muscle activity and the velocity of overhead throws. Therefore, the purpose of this pilot study was to investigate the effect of taping (Kinesio tape, placebo tape, and no tape) on the velocity of an overhead baseball throw and muscle activity using surface electromyography (EMG) and a radar gun in a population of baseball players.

METHODS: 13 participants (9 female and 4 male) completed two testing sessions with at least 24 hours between sessions. Each session consisted of a dynamic warm-up, two practice

overhead throws at their maximal velocity, and then completed three overhead throws at their maximum velocity while EMG muscle activity (mV) and throwing velocity (km/h) were measured. A Trigno™ Wireless Delsys© EMG system, Trigno™ IM sensors and a Sports Radar SR3600 were used for this study. Muscle activity was measured with wireless surface EMG applied to the supraspinatus, infraspinatus, teres minor, and pectoralis major muscles (Konrad; 2006). EMG data was rectified to create a linear envelope with a bandpass filter of 10 Hz and the absolute mean value between trials was used for EMG values in the analysis. Velocity of overhead throws was measured with a radar gun. The maximal velocity throws were completed under three taping conditions (no tape, placebo tape, and Kinesio tape) with the mean velocity statistically analyzed using a Friedman Test with a $p<.05$. Surface EMG was measured during the three overhead maximal throws and was analyzed using a 3 tape condition (Kinesio tape, no tape, and placebo tape) X 4 muscle type (supraspinatus, infraspinatus, teres minor, and pectoralis major muscles) repeated measures ANOVA with a $p<.05$.

RESULTS: There was no statistically significant difference in throwing velocity between the application of the different taping conditions, $X^2(2) = 2.471$, $p = .291$. The throwing velocity for each tape condition was as follows: placebo tape (*Mdn*=59.5 km/h), Kinesio tape (*Mdn*=54.7 km/h), and no tape (*Mdn*=51 km/h).

Table 1: Muscle activity for between each muscle in each tape condition.

	Kinesio Tape			**No Tape**			**Placebo Tape**		
	Mean	SD	n	Mean	SD	N	Mean	SD	n
Supraspinatus Mean EMG (mV)	.6188	.63	13	1.3655	1.63	13	2.4939	2.21	13
Infraspinatus Mean EMG (mV)	.7951	1.43	13	.3463	.32	13	.4278	.75	13
Teres Minor Mean EMG (mV)	1.0081	1.4194	13	1.7878	2.09	13	1.7973	1.99	13
Pectoralis Major Mean EMG (mV)	1.7774	2.26	13	1.6455	1.98	13	1.7866	2.11	13

There was a statistically significant two-way interaction between tape and the muscle type, $F(6,66) = 2.656$, $p < .05$, partial $\eta^2 = .769$. Therefore, to further explain this interaction effect repeated measures one-way ANOVAs were conducted. There was a statistically significant difference in muscle activity in the supraspinatus muscle ($M = 1.3655$, $SD = 1.63$), infraspinatus muscle ($M = .3463$, $SD = .32$), teres minor muscle ($M = 1.7878$, $SD = 2.09$), and pectoralis major muscle ($M = 1.6455$, $SD = 1.98$) for the no tape condition, $F(3, 36) = 3.235$, $p = .033$, $\eta^2 = .212$. An LSD pairwise comparison was then conducted to further examine this relationship. There was a decrease in muscle activity in the infraspinatus muscle compared to the supraspinatus muscle in the no tape condition with a statistically significant mean decrease of 1.308 mV, 95% CI [.238, 2.379], $p < .05$. There was a decrease in muscle activity in the infraspinatus muscle compared to the teres minor muscle in the no tape condition with a statistically significant mean decrease of 1.643 mV, 95% CI [.319, 2.968], $p < .05$. Additionally, there was a decrease in muscle activity between the infraspinatus compared to the pectoralis major muscle in the no tape condition with a statistically significant mean decrease of 1.540 mV, 95% CI [.223, 2.856], $p < .05$.

DISCUSSION: The purpose of this pilot study was to investigate the effect of taping (Kinesio tape, placebo tape, and no tape) on the velocity of an overhead baseball throw and muscle activity using surface EMG and a radar gun in a population of baseball players. Previous literature is conflicting on the effects of Kinesio tape on muscle activity and the results of this pilot study followed this trend. Additionally, the Kinesio tape did not significantly increase the velocity of an overhead baseball throw.

There was a statistically significant interaction effect between no tape and muscle type. Upon further investigation it was found there was a statistically significant difference between muscles in the no tape condition. There was a statistically significant mean decrease in muscle activity in the infraspinatus muscle compared to the supraspinatus, teres minor, and pectoralis major muscles in the no tape condition. This could mean that the application of placebo tape and Kinesio tape may inhibit muscle activity of the supraspinatus, teres minor, and pectoralis major muscles. Kase et al. (2013) stated that the application of Kinesio tape to the rotator cuff may inhibit muscle activity. Therefore, the Kinesio tape condition in this pilot study may have inhibited muscle activity of the supraspinatus, teres minor, and pectoralis major muscles. More research needs to be conducted; however, to discover if tape has an effect on muscle activity and to fully understand the clinical utility of applying tape to the shoulder.

There was no significant difference in velocity between the Kinesio tape and no tape condition or between the Kinesio tape and placebo tape condition. Measuring the velocity of the overhead baseball throw was an exploratory piece of this pilot study, as no previous literature had analyzed the velocity of overhead throwing under three different taping conditions.

The limitations for this pilot study included no control for sex and skill level of players. Mean absolute values of EMG data was used and EMG data was not normalized due to this being a pilot study as well as the main interest of this study differences between tape conditions within participants.

CONCLUSION: The purpose of this pilot study was to investigate the effect of taping (Kinesio tape, placebo tape, no tape) on the velocity of an overhead baseball throw and muscle activation using surface electromyography and a radar gun in a population of baseball players. There was a statistically significant two-way interaction between tape and the muscle type. Upon further investigation, a statistically significant mean decrease in muscle activity in the infraspinatus muscle compared to the supraspinatus, teres minor, and pectoralis major muscles under the no tape condition was discovered. The information gained from this pilot study may be useful for coaches as well as healthcare professionals who may use tape in their practices. More research needs to be conducted on the application of tape to the shoulder to investigate if it does have a significant effect on muscle activity and performance.

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