THE EFFECT OF KINESIOTAPING COMPARED TO NO TAPE ON SURFACE EMG ACTIVITY OF THE SHOULDER MUSCLES DURING OVERHEAD FUNCTIONAL MOVEMENTS

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The purpose of this study was to compare the effects of Kinesio Tape (KT) to no tape on electromyographic (EMG) activity of the teres minor (TM), infraspinatus (IS), and supraspinatus (SS) muscles when completing a variety of functional movement patterns. Thirty healthy individuals performed three repetitions of reaching into flexion, abduction, and external rotation with and without KT. The mean absolute EMG activity (mV) was recorded using a Delsys Trigno Wireless EMG System. There was a significant increase in EMG activity for the IS during external rotation, ($t(21)=2.532$, $p=.019$); and a significant decrease in TM, ($t(21)=2.018$, $p=.057$); and SS ($t(21)=2.190$, $p=.04$) during flexion with tape. Therefore, the application of tape may assist clinicians in altering (facilitating or decreasing) specific rotator cuff muscle activity level.

KEY WORDS: kinesio tape, electromyography, shoulder, function

INTRODUCTION: Kinesio Tape (KT) is a type of therapeutic tape that was developed by Kenso Kase in the 1970s (Donec et al., 2012; Kase 2003). It has since become an increasingly popular taping technique used by a variety of patient and athletic populations with many unique features reported that separate it from other types of therapeutic tape.

Kase (2003) proposed a wide variety of benefits with the application of KT including facilitating or inhibiting muscle activity, decreasing inflammation, and decreasing pain. Kinesio Tape is also believed to have mechanical benefits including altering posture, improving joint function, and improving muscle mechanics possibly aiding in injury prevention (Donec et al., 2012; Fu et al., 2008; Huang et al., 2011). It is also reported that these benefits may be the result of increased motor unit recruitment, increased blood flow to the region, and improved lymphatic fluid circulation (Donec et al., 2012; Fu et al., 2008).

One area in which tape is commonly used as a therapeutic intervention, is the shoulder joint. The shoulder's ability to function properly impacts essential daily functional tasks performed in one's everyday life by being the medium to controlling the hand and may be a focal point for a person's occupation, for functional tasks requiring overhead work, and for many athletes participating in overhead sports such as basketball, volleyball, or tennis (Simsek et al., 2013).

There is limited research, however, examining the effect of KT on the EMG activity of the rotator cuff muscles. The small numbers of studies that are available have used a variety of patient populations with various shoulder disorders along with different types of tape, methods of application, and research designs. Therefore, the purpose of this study was to examine the effects of KT compared to no tape on the EMG activity of the teres minor (TM), infraspinatus (IS), supraspinatus (SS) muscles during the completion of three commonly used functional movement patterns including reaching overhead in a flexed position, reaching out to the side in an abducted position, and with externally rotating the shoulder out to the side.

METHODS: Thirty healthy individuals (18 male, 12 female; mean age 21.06±1.8 years; mean height 1.70±0.08 m; mean mass 69.55±12.94 kg; mean body mass index 23.79±4.01 kg/m^2) participated in the study. Participants were excluded from the study if he/she: 1) suffered from a diagnosed upper extremity injury in the past six months (e.g., tendinitis, muscle strain, ligament sprain, or dislocation); 2) suffered from an upper extremity fracture or sustained shoulder surgery in the past five years; and 3) were allergic to any type of tape, adhesive, or glue.

Before data collection commenced, ethical approval was obtained from the academic institution. All participants provided written consent and completed a Physical Activity Readiness Questionnaire. Upon completion of the required documents, the participant was guided through a brief warm up activity. The participant was then asked to indicate which side was their dominant shoulder and this was then used for data collection. Prior to the placement of the EMG electrodes, the participant's skin was cleaned with an alcohol swab to remove excess skin oils or dry skin (SENIAM, 2015). The Delsys Wireless EMG sensors were then placed on the TM, IS, and SS muscles according to the guidelines by Perotto (2000).

The participant was then positioned in sitting with his/her back resting against a chair with a back support and feet resting on the ground; maximal voluntary contraction (MVC) EMG activity (mV) for the SS, IS, and TM was recorded. This was then followed by having the participant complete three trials of reaching into flexion, abduction, and external rotation and the EMG activity was recorded without tape with 30 seconds of rest in between each trial.

After completing the functional movements without tape, KT using a facilitatory mechanical correction technique as described by Kinesio Taping Association International (2013) was applied. The taping technique applied used a single I-strip; the length of the piece of tape was determined by measuring the distance from the medial end of the spine of the scapula to the lateral side of the humeral head. The KT was cut to that length and corners of the tape were rounded. The I-strip was then anchored with no tension starting at the medial end of the spine of the scapula. While holding the anchored position in place, the tape was laid down with 50-75% paper off tension and applied against the skin extending across the lateral aspect of the head of the humerus and ending on the anterior side of the humeral head where it was anchored with no tension. The tape was then rubbed against the participant's skin to ensure that it was firmly adhered to the skin, activating the adhesive in the KT. The participant was then asked to perform the same procedures as previously described for the no tape condition and the EMG activity measured as described previously.

Mean EMG activity obtained from each trail was normalized as a percentage of MVC. Descriptive statistics were used to compare means and standard deviations of the filtered and rectified mean absolute value EMG activity. One independent variable (type of intervention – tape versus no tape) and one dependent variables (mean EMG activity) of the shoulder were examined. Statistical analysis was completed using IBM SPSS statistics version 22 with a significance level set at $p<.05$. The data was then analysed using a paired-samples t-test to determine differences in functional movement patterns between tape and no tape conditions in relation to EMG activity.

RESULTS: Descriptive statistics for the EMG activity of the IS, TM, and SS during functional movement testing is summarized in Table 1. Inferential statistics revealed that there was a significant increase in EMG activity for the IS muscle during external rotation ($t(21)=2.532$, $p=.019$) with tape when compared to without tape. There was no significant differences in SS ($t(21)=0.134$, $p=.894$) and TM ($t(21)=.593$, $p=.560$) EMG activity during external rotation when comparing with and without tape conditions. There was also a significant decrease in EMG activity for the TM muscle ($t(21)=2.018$, $p=.057$) and SS muscle ($t(21)=2.190$, $p=.04$) during flexion with tape when compared to without tape. There was no significant difference in IS ($t(21)=1.1318$, $p=.202$) EMG activity during flexion when comparing with and without tape conditions. There was also no significant difference in EMG activity for the IS muscle ($t(21)=0.112$, $p=.912$), TM muscle ($t(21)=1.224$, $p=0.235$, or SS muscle ($t(21)=.119$, $p=.907$) during abduction across taping conditions (see Figure 1).

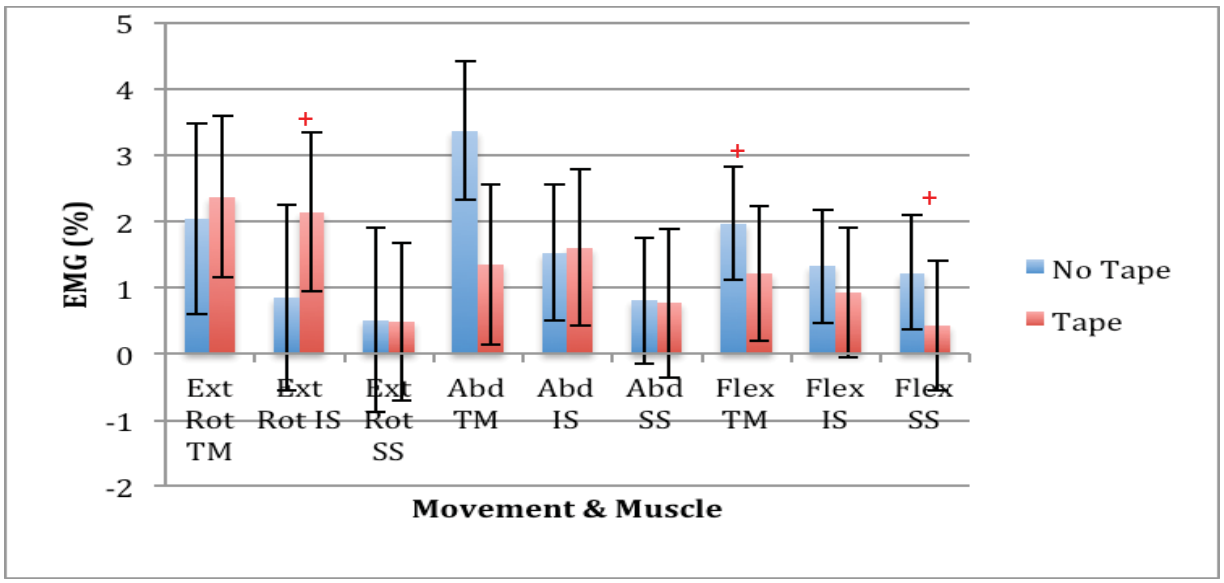

Figure 1. EMG activity during functional shoulder range of motion testing for external rotation, abduction, and flexion for the TM, IS, and SS muscles with no tape compared to with KT. + denotes statistically significant difference.

DISCUSSION: Based on the results of this study, there were significant changes noted in the EMG activity with the application of KT to the shoulder. There was an increase in EMG activity for the IS during external rotation with tape and a decrease in EMG activity for the TM and SS during flexion. There were no significant changes in EMG activity for the TM, IS, and SS muscles during abduction. The higher EMG activity may be the result of an increased firing rate of the motor units or the recruitment of larger motor units involved in the activity (Powers & Howley, 2007). Under either of these conditions (tape versus no tape), the force produced by the TM muscle may result in greater force production. This may impact the performance of the functional movement and be beneficial in activities that require increased amounts of shoulder external rotation such as during part of the wind up phase during overhand throwing or overhead racquet sports.

Conversely, the reduction in muscle activity in the select muscles may be beneficial clinically in reducing or preventing over activity and possibly the development of overuse injuries such as a tendonitis or tendinosis. This reduction in activity was evident with the application of tape in the TM and SS muscles during the forward flexion task. This finding may support the use of taping in individuals that must perform repetitive flexion as part of their functional movement patterning, sport, or occupational task to prevent overuse injuries. This intervention may also help as a preventative strategy or, alternatively, may help to prevent further injury in individuals who may already have damage to that tissue (e.g., individual with a partial tear in the rotator cuff muscles such as the SS or TM muscle).

These findings are similar to what has been found in previous literature in which therapeutic taping has been used in other areas of the body. For example, Huang et al. (2012) reported significant increases in EMG muscle activity of the medial gastrocnemius muscle during vertical jumping after applying KT, but did not find significant improvement in vertical jump height performance. Similarly, Donec et al., (2012) also found significant improvements in grip strength and key pinch force and EMG activity, but this was not present immediately after taping but in follow up testing 30-60 minutes after the tape was applied.

The results of the current study add to the limited research about the proposed effects of tape on the shoulder. Further research is required examining the effect of therapeutic taping in a pathological population with rotator cuff tendonitis, tendinosis, or tearing to see if similar results are found.

CONCLUSION: In conclusion, there is very limited research into the effects of KT on the rotator cuff EMG muscle activity. Our findings suggest that therapeutic taping applied to the shoulder may alter muscle activity when completing reaching or functional movement patterning into a flexed, abducted, or externally rotated position. Further research into the effect of KT on the rotator cuff muscles is required so that a better understanding of the clinical utility of therapeutic taping in rehabilitation, occupational, or sport performance applications is understood.

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