Is there an effect on decreasing muscle tone with medical tape applied to the m. Rectus Femoris in students with a positive modified Thomas Test?

A pilot study

Beck Lisa¹, Hagenbrock Julianna¹, Hoyer Bernadette¹, Koss Joscha¹, Munz Julian¹, Plunger Martina¹
¹ Undergraduate Physiotherapy Student

Abstract

Objective: Determine the short-term effect of medical tape on the tone of the m. Rectus Femoris in healthy students with a positive Modified Thomas Test.

Background: Medical taping has gained popularity, although its effectiveness is inconclusive. Medical tape increased trunk flexion ROM, and it is assumed that effects transfer elsewhere in the body.

Methods and Materials: Fifty-two subjects (104 legs) were included. Each participant's legs were randomized, one leg to the taped-group, one to the non-taped-group. Each knee ROM was measured at baseline, two days-, and one week-post-tape application. 3-by-2 ANOVAs determined effects of medical tape intervention over time, and between groups.

Results: The group-by-time interaction for the 2-by-3 mixed-model ANOVA was not statistically-significant for ROM (p > 0.05), indicating absence of taped leg’s increased ROM in comparison to non-taped leg over time.

Conclusion: Medical tape applied to the m. Rectus Femoris in healthy students showed no statistically significant effect on decreasing muscle tone.

Keywords: Taping, Medical Taping, Kinesio Taping, Muscle tone, modified Thomas test, CureTape®

Introduction

The original concept of the medical taping technique was developed by Dr. K. Kase in the 1970s in Korea and Japan (Gwang-won, 2005). After the 2008 Summer Olympic Games, where the tape was seen on various athletes, the taping method has gained significant popularity, even though the therapeutic effects of it remain to be elucidated. Medical tape is an elastic tape that allows stretch in a longitudinal direction, which can be applied to the skin without restricting joint range of motion (ROM) (Gonzalez-Iglesias, et al., 2009), making it useful in sports. Gwang-won has hypothesized that medical taping can regulate muscle tone, improve blood and lymphatic circulation, alleviating pain, and enhance joint stability (2005). Applied in a longitudinal direction to the muscle belly, medical tape applied with stretch from insertion to origin decreases muscle activity (decreases tone), and vice versa facilitates muscle activity (increases tone) (Kase, et al., 2003; Hsieh, et al., 2007; Yoshida, et al., 2007). According to Yoshida et al., medical tape applied to the m. Sacrospinalis improved active ROM in lower trunk flexion (2007). As Yoshida et al. found an increased ROM in trunk flexion, it was assumed that a similar effects could be seen elsewhere in the
A study performed by Slupik et al. showed increased electromyography activity of the medial head of the quadriceps muscle after the application of a tape to increase muscle tone (2007). Taking this into consideration, the researchers propose that the tape could still have a decreasing effect on muscle tone. According to the limited evidence in literature on its effect on muscle tone, the researchers designed this study with the purpose of investigating the short-term effects of medical tape application on the tone of the m. Rectus Femoris, compared to an un-taped leg. Hypothesized was a decrease of muscle tone and therefore an increase in knee ROM after 2 days, and 1 week post-medical tape application.

Methods & Materials

Participants
73 subjects were recruited at the Amsterdam School of Health Professions (ASHP) and baseline demographics were recorded via an online questionnaire (Appendix 1). To be included, students had to be generally healthy, with no acute knee or hip complaints. Figure 1 is a flow-chart of patient recruitment, exclusion, and inclusion.

Baseline measurements
After signing an informed consent form, the subjects’ left and right knee flexion were measured using a goniometer during the Modified Thomas Test (ModTT) (Harvey, 1998) (also known as: Kendall test or Rectus Femoris contracture test (Magee, 2006; Peeler & Anderson 2008) to determine length of m. Rectus Femoris. When positive, the knee was passively flexed further to differentiate between actual shortness and hypertonicity of the m. Rectus Femoris. If further flexion was possible, the decreased angle was considered to be caused by the hypertonicity of the m. Rectus Femoris. Gabbe et al state the ModTT is reliable (2004). According to Brosseau et al, goniometric measurements can be highly reliable when taken by the same therapist, but it is inadvisable for multiple therapists to complete the measurements interchangeably (1997), in particular when measuring knee ROM (Lenssen, et al., 2007).

To increase the reliability of the ModTT and goniometric measurements a protocol (Appendix 2) was set. One researcher marked each subject’s trochanter major, lateral joint line of the knee, and the lateral malleolus, allowing precise positioning of the goniometer. A carpenter’s level was attached to the goniometer, so the thigh position could be standardized to the horizontal. For exact alignment of the goniometer to the malleolus, an extra-long arm was attached (Figure 2).

Figure 2: Goniometer

Intervention
Subjects with bilateral m. Rectus Femoris hypertonicity were included. A coin was flipped for randomization to avoid a dominant / non-dominant leg bias. One leg of every subject was randomly allocated to the medical tape group and the other leg to the non-taped control group. 5 cm-wide CureTape® (FysioTape B.V., Enschede) was applied to the intervention leg with 15-25% tension of the resting length (Kase, et al., 2003) from the
insertion of the m. Rectus Femoris to its origin (Figure 3). The subjects were instructed not to remove the tape until second appointment unless persistent skin irritation or discomfort occurred. Subjects were instructed to follow their daily activities.

Follow-up measurements
Two days later, the tape was removed and the knee flexion was measured anew (Appendix 2). One week post-tape application, knee flexion was measured again to see if there were any measurable residual ‘long-term’ effects. Any time disputes arouse in measurements it was redone. Results from previous measurements were blinded from the researchers performing the measurements while all results were kept from the participants.

Statistics
Data were analyzed with SPSS, Version 18.0. Baseline demographic variables and scores on self-reported measures (online questionnaire) were checked for significant differences, using independent t test. Separate 3-by-2 mixed-model analyses of variance (ANOVAs) were used to examine the effects of taping intervention as the dependent variable with group (taped leg or control leg) as the between-subject variable and time (baseline, two-day follow-up, one-week follow-up) as the within-subject variable. The hypothesis of interest was the group-by-time interaction at a set significance level of p < 0.05.

Results
56 subjects agreed to participate and 52 subjects (22.0 ± 4.3 years old, 62 % female, sporting hours / week 3 ± 1.5 h, sitting hours / week 7.7 ± 2.0 h) satisfied the eligibility criteria. Baseline demographics were similar for all variables due to the leg-to-leg comparison, except the male/female ratio.

Table 2: Baseline Demographics

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Male</th>
<th>Female</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>20</td>
<td>32</td>
<td>62 %</td>
</tr>
<tr>
<td>Age</td>
<td>24.2</td>
<td>20.7</td>
<td>0.000</td>
</tr>
<tr>
<td>Sporting hr / week</td>
<td>3.4</td>
<td>2.9</td>
<td>0.119</td>
</tr>
<tr>
<td>Sitting hours / day</td>
<td>6.9</td>
<td>8.1</td>
<td>0.004</td>
</tr>
<tr>
<td>ROM in degrees</td>
<td>66.25</td>
<td>71.36</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 1 summarizes mean ± SD knee ROM for Baseline, 1st follow-up, and 2nd follow-up and P-values for group comparisons.

Secondary outcome – For all subjects (n = 52), statistically significant differences in numbers of participants, average age, average sitting hours / day, and average knee ROM were found between male and female participants (see Table 2).

Discussion
The results of the current study found that medical tape applied to m. Rectus Femoris showed no statistically significant effect on decreasing muscle tone compared to the non-taped leg in a population of healthy students.

<table>
<thead>
<tr>
<th>ROM in ° of knee flexion</th>
<th>Baseline (n = 52)</th>
<th>1st follow-up (n = 49)</th>
<th>2nd follow-up (n = 47)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Tape group</td>
<td>69.35 ± 7.90</td>
<td>71.51 ± 7.19</td>
<td>72.79 ± 7.60</td>
</tr>
<tr>
<td>Control group</td>
<td>69.44 ± 8.58</td>
<td>69.76 ± 8.81</td>
<td>73.19 ± 8.08</td>
</tr>
<tr>
<td>P-values</td>
<td>0.95</td>
<td>0.28</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table 1: Mean ROM for Baseline & follow-ups
The hypothesis must be denied in the short-term (2 days), with no residual effects seen one week post-application. This study fails to support results found by Yoshida, et al. (2007) that medical taping improved ROM in the lower back in healthy patients. While both studies measured tonicity via an increase in ROM, it is difficult to compare results from the knee to the lower back however. Results of increased ROM seen in unhealthy participants (Gonzalez-Iglesias et al., 2009; Thelen et al., 2008) are incomparable to the results found in this study of healthy participants. It is possible that the increased ROM in unhealthy participants was due to decreased pain and/or edema, which are documented effects of medical tape (Kase, et al., 2003).

The results of this study could be attributed to confounding factors such as differences between participants or problems with the methods of the study. More-severely hypertoned participants would be likely to show an obvious decrease in ROM. Baseline demographics show that the women had a greater knee ROM than the men. It is therefore possible that the effects of the tape could not be seen since more women participated in this study than men. It is also possible that the tape did decrease the muscle tone of the m. Rectus Femoris, but that the decreased tone did not show in knee ROM, and therefore the ModITT was not an appropriate means of measuring tonicity of the muscle.

Complete blinding of the participants was not possible. As the students were in the medical fields, it was common for them to have prior knowledge of medical taping. Additionally, the tape was obvious on their leg. One researcher, using a permanent pen, completed all of the landmark palpations throughout the study. In some cases, the marks were still there at one or two of the follow-up appointments, but sometimes were not. Therefore, the palpations needed to be redone, increasing chances of inconsistencies in measurement. According to Brosseau et al., goniometric measurements can be highly reliable when taken by the same therapist, but it is inadvisable for multiple therapists to complete the measurements interchangeably (1997), in particular when measuring knee ROM (Lenssen et al., 2007). Due to scheduling problems and time constraints, the investigators had two researchers complete the goniometric measurements, and two researchers apply the tape. Although the measurement procedure was thoroughly discussed and practiced before the onset of the study, ultimately, goniometric measurement has higher intra-rater reliability than inter-rater reliability (Gabbe et al 2004; Brosseau, et al., 1997). On occasion, measurements were redone, which could lead to a decrease in tone with each subsequent stretch, and therefore an increase in ROM. Additionally, the researchers could not access a bubble goniometer with extended arms, and therefore created their own version; this tool has not yet been validated. Gonzalez-Iglesias et al. found that the tension of the applied tape made a significant difference, having used a sham-tape (application of un-stretched tape) control group vs. a tension-added taped intervention group (2009). Therefore, having two researchers apply the tape decreased the validity of this study, as inevitably, there would be differences between the amounts of stretch applied by each researcher. It is also possible that the researchers did not use enough stretch, therefore not getting a positive outcome. The tape did not stay applied perfectly to all participants, often having detached at the ilium or around the patella. Six participants reported discomfort (two in the groin, four in the knee) after tape application, and four reported the tape to be irritable. Only one participant felt the pain severe enough to stop the study early, however. In addition, four participants were lost for not returning for subsequent measurement due to conflicts in their schedules.

Conclusion

The results of the current study found that medical tape applied to m. Rectus Femoris showed no statistically significant effect on decreasing muscle tone compared to the non-taped leg in healthy students.

Implication for Practice

Since physical therapist around the world have had good practical experiences with medical tape but still no conclusive scientific results are presented, every physical therapist should individually decide when to use a medical taping application. A thorough assessment and skilled understanding of the medical taping principle presumed.
Implication for Future Research

Future researchers should use established and validated methods of measuring muscle tone, for example EMG measurements, as previously described by (Slupik et al., 2007). Secondly, researchers should have one person completing all measurements. Adding a sham-taping group would be wise to allow more effective blinding and better comparisons. Another field of research should focus on finding the mechanisms as to how medical tape has an effect on physiologically and biochemically levels in the body to be able to transfer these findings to correct medical tape application.

Contact & Online Appendices

Email: hva.researchgroup@gmail.com
URL: BAS PLEASE ENTER VALID URL TO DOC

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Key points

- **Background**: Medical taping is a relatively new treatment technique and research findings lack in quantity and quality. It is claimed that medical tape should have an effect on decreasing muscle tone what was going to be tested.
- **Findings**: There seems to be no effect of medical tape applied on the m. Rectus Femoris on decreased muscle tone in healthy subjects.
- **Implications**: The results do not advise to apply medical tape to decrease muscle tone. However, previously findings throughout research vary in outcome and therefore the practitioners’ evaluation about findings is presumed.

References