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Section: Original Research Report

Article Title: Effects of Kinesio-Taping on the Relief of Delayed Onset Muscle Soreness: A Randomized, Placebo-Controlled Trial

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Running Head: Effects of Kinesio-Taping on DOMS

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The present study was carried out at the Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University.
ABSTRACT

Objective: The purpose of this study was to examine the effects of Kinesio-Taping (KT) on delayed onset muscle soreness (DOMS). Design: Randomized controlled study. Setting: Clinical laboratory. Participants: Fifty-four non-athletic volunteers were assigned randomly in KT (n=27) and placebo KT (n=27) groups. Interventions: The intense exercise protocol consisted of 100 consecutive drop-jumps from a 0.60 m high platform. Kinesio-tape was applied with the fan technique on the quadriceps muscles in the KT group. The placebo KT group received the Kinesio-tape with no technique and tension. Main outcome measure: Muscle soreness, maximal isometric quadriceps muscle strength, vertical jump height, and blood analyses (creatine kinase, lactate dehydrogenase, myoglobin, and C-reactive protein) were measured pre-, immediately post-, 48 h post-, and 72 h post-exercise. Results: There was a significant effect of time in all outcome measures (p<0.05), except serum C-reactive protein level (p>0.05). The intensity of muscle soreness was significantly lower in the KT group relative to the placebo KT group at 72 h post-exercise (p=0.006). The serum creatine kinase level was significantly higher in the KT group compared to the placebo KT group at 72 h post-exercise (p=0.012). There were no statistically significant differences between groups for the other outcome measures (p>0.05). Conclusion: These findings indicate that KT intervention following the intense exercise protocol reduces muscle soreness. However, it has no effects on maximal quadriceps isometric strength and vertical jump height, as well as serum lactate dehydrogenase, myoglobin, and C-reactive protein levels. Furthermore, KT application after intense exercise also increases serum CK level.

Keywords: exercise; muscle damage; kinesio-taping; muscle strength; jump performance; creatine kinase
Introduction

Delayed onset muscle soreness (DOMS) is a well-known phenomenon and occurs after unaccustomed or strenuous exercise, particularly if the exercise involves a lot of eccentric contractions.\(^1\) Many theories have been proposed to explain the mechanism of DOMS, such as lactic acid accumulation, muscle spasm, connective tissue damage, muscle damage, inflammation, and enzyme efflux theories.\(^1,2\) However, an integration of two or more theories is likely to explain muscle soreness. Symptoms of DOMS include muscle soreness, swelling, reduction in the range of motion, maximal strength, and performance, and increases in muscle damage and inflammatory markers in blood.\(^3,4\) The intensity of discomfort and soreness associated with DOMS increases within the first 24 h, peaks between 24 and 72 h, and eventually disappears 5–7 days after the exercise.\(^5\) In light of this phenomenon, many interventions have been previously examined in an attempt to alleviate the associated side effects of this type of exercise.\(^2,5,6\) However, there still remains to be no gold standard treatment for DOMS.

Kinesio-taping for lymphatic drainage is an alternative intervention for healthcare professionals. According to the Kinesio-tape manufacturers, the tape causes micro convolutions or folds in the skin, which causes a lifting of the skin away from the tissue beneath.\(^7,8\) This lifting effect of KT may facilitate a release in pressure on soft tissues underneath and provides space for lymphatic fluid movement.\(^9\) The manufacturers also suggest that the increase in lymphatic fluid movement can decrease edema, pain, and muscle spasm, and improve range of motion and muscle strength.\(^7,8\) Thus, it could be postulated that KT would be an effective means to enhance recovery after DOMS. Several studies investigated the effects of KT on muscle damage after exercise.\(^10-12\) Lee et al.\(^10\) reported that KT reduced pain and improved muscle function and strength compared to no KT following eccentric exercise in healthy males. In contrast, Ozmen et al.\(^11\) suggested that KT application immediately before
squat exercise had no effect on muscle pain and short sprint performance but maintained muscle flexibility compared to no KT application. However, Lee et al.\textsuperscript{10} did not mention which technique of KT was applied, while Ozmen et al.\textsuperscript{11} did not use conventional muscle damage protocol and measure other markers of muscle damage. Nevertheless, there is insufficient evidence to support the use of KT on muscle damage after exercise.

Therefore, we hypothesized KT following the intense exercise protocol would have positive effects on symptoms associated with DOMS. The aim of this study was to investigate the effects of KT on DOMS over 72-hour period after an intense exercise protocol.

**Methods**

**Experimental Design**

This study was designed as a single blind, randomized, placebo-controlled trial. Independent variables were the 2 conditions: KT and placebo KT. Dependent variables consisted of muscle soreness, maximal isometric quadriceps strength, vertical jump height, and blood analyses (creatine kinase, lactate dehydrogenase, myoglobin, and C-reactive protein). Power analysis indicated that the required sample size to evaluate a time × group interaction (with 80\% of statistical power and p < .05) was 27 subjects per group. The study was approved by an ethics committee (Gazi University, date: 10.03.2014, decision number: 129). Informed consent was obtained from all subjects included in the study.

**Subjects**

Sixty healthy non-athletic subjects were enrolled; of these, six were excluded because they did not meet the eligibility criteria. Four subjects declined to participate, one had previously undergone a lower extremity surgery, and one was excluded because of a history of asthma (Figure 1). Consequently, fifty-four healthy non-athletic subjects were randomly assigned to the KT and the placebo KT group using computer-generated random numbers.
Both groups were homogeneous in terms of age, height, weight, and BMI (Table 1). The inclusion criteria were as follows: 1) age between 18 and 30 years, and 2) subjects who did not regularly conduct strengthening exercises on lower extremities. The exclusion criteria were: 1) subjects who had surgery involving a lower extremity within the previous six months, 2) those with an orthopedic disease, neurological impairments, cardiopulmonary disease, open leg wound, or pregnancy. Additionally, subjects were asked to refrain from consuming alcohol and caffeine, the use of pain relievers and analgesics, and activities that may cause damage, soreness, and hence influence dependent variables for the duration of the investigation. Subjects also kept a dietary log of all items ingested during the 72-hour period.

**Exercise Protocol**

Subjects performed a total of 100 drop-jumps from a height of 0.6 m. Upon landing, subjects were instructed to jump vertically with maximal force immediately. Five sets of 20 drop-jumps were performed with a 10 s interval between each jump, and a 2 min rest was given between sets. This protocol has been previously shown to cause significant elevations in muscle damage indices.13-15

**Intervention**

Before KT application, the skin was cleaned with alcohol. KT was performed by a certificated physiotherapist immediately after the exercise protocol. Kinesio-tape was applied according to the Kinesio-taping Manual Guidelines recommended by Kenzo Kase. In the KT group, taping was applied to quadriceps muscles in the supine position. The base of the tape must be implemented to the distal to proximal as webcut. While stabilizing the base, KT was peeled from the paper to the base of tails and placed on the skin with 5% to 10% tension. Next, the subjects were instructed to flex both hip and knee maximally. A second fan tape strip applied in a crisscross weave pattern across the area of the first taping.7,8 In the placebo KT
group, a single I strip of the same tape applied with no tension to the lateral edge of the thigh (Figure 2). The tape was left on the subject’s skin for the next 72 h. Subjects were instructed to continue their normal daily routine.

**Outcome Measures**

All measurements were performed in the same order, which was supervised by the same investigator. All outcome measures were recorded at pre-, immediately post-, 48 h post-, and 72 h post-exercise.

**Muscle Soreness**

Subjects were asked to perform a squat (90° knee angle measured using a goniometer) while they rated their perceived muscle soreness on a 100 mm visual analog scale. The scale consisted of a line from 0 mm (no muscle soreness at all) to 100 mm (the most severe muscle soreness that I can imagine).¹⁶

**Maximal Isometric Strength**

Quadriceps muscle strength was assessed using a hand-held digital dynamometer (Nicholas Manual Muscle Tester, Lafayette® Instruments, USA). The subjects were seated with hips and knees at 90° flexion and then was instructed to extend the knee fully. The dynamometer was placed just above the ankle and resistance was applied downward over 1 second. Following a familiarization test, subjects performed two trials with standardized verbal encouragement, and the peak force (kg) maintained for over half a second was recorded.¹⁷

**Vertical Jump Test**

Subjects stood with their side to the wall and one arm stretched by the wall towards the ceiling. Keeping the feet flat on the ground, the point of the fingertip was recorded using the measuring tape hanged on the wall. This is referred to as standing reach height. The subjects jumped with an arm swing as high as possible and the wall was marked with chalk at the highest
point their fingertip reached. The difference in distance between the standing reach and the jump height was measured as the vertical jump. Each subject was familiarized with the test procedure before the recorded efforts and received verbal encouragement for each trial. Two trials separated by a 60 s rest were performed, and the mean value was used for data analysis.18

**Biochemical Analyses**

Blood samples of 5 ml were collected in vacutainer tubes via antecubital venepuncture. The blood was allowed to clot for 30 min at room temperature and centrifuged for 10 min to obtain serum. The serum activities of creatine kinase (CK), lactate dehydrogenase (LDH), and myoglobin were analyzed as parameters of muscle damage. A high-sensitivity C-reactive protein (hs-CRP) test, which is more sensitive than a standard test, was interpreted as a parameter of inflammation.19 Serum CK and LDH activity were determined spectrophotometrically using a commercially available kit (Abbott® Laboratories, Chicago, IL, USA). The reference range of serum CK is 30-200 U/L for men and 29-168 U/L for women. The normal value range for LDH is 105 - 333 IU/L. Myoglobin concentration was also measured using a commercially available kit (Abbott® Axsym System, USA). Normal reference range of myoglobin is <154 ng/mL for men and <140 ng/mL for women.20,21

**Statistical Analysis**

All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) Version 15.0 (SPSS®, Inc, Chicago, IL, USA). The results were presented as median and minimum-maximum. The Mann-Whitney test was used to analyze the differences between KT and placebo KT groups at each time point during the study. The Friedman test was used to evaluate the changes in each variable among the time periods of the study for each group separately. If there was a significant difference among time periods, we used the Wilcoxon
signed rank test with the Bonferroni correction method to identify which two periods were statistically different. Statistical significance was set at p<0.05.

**Results**

**Muscle Soreness**

Muscle soreness was significantly increased immediately post-exercise and peaked at 48 h post-exercise in both groups (p<0.05). Muscle soreness decreased and reached near to the pre-exercise level at 72 h post-exercise in the KT group; however, it was significantly higher in the placebo KT group (p<0.05) (Table 2).

**Muscle Strength**

Maximal quadriceps isometric muscle strength decreased immediately post-exercise and failed to reach the pre-exercise level even at 72 h post-exercise in both groups (p<0.05). Maximal quadriceps muscle strength changes in both groups were similar at all time periods (p>0.05) (Table 2).

**Vertical Jump Test**

The decrease in vertical jump height was started immediately post-exercise in the placebo KT group; however, it began at 48 h post-exercise in the KT group. Even at 72 h post-exercise, vertical jump height was significantly lower in both groups compared to the pre-exercise values. Vertical jump height changes in both groups were similar at all time periods (p>0.05) (Table 2).

**Biochemical Analyses**

Serum CK level increased immediately post-exercise and peaked at 48 h post-exercise in both groups. The serum CK level decreased to the pre-exercise level at 48 h and 72 h post-exercise in the placebo KT group. In the KT group, the serum CK level was found significantly high at 72 h post-exercise (p<0.05) (Table 3).
The serum LDH level was found similar at all time periods in the KT group. However, it was significantly increased at 72 h post-exercise in the placebo KT group. There were no significant differences in serum LDH levels between groups (p>0.05). Serum myoglobin levels increased immediately post-exercise and significantly decreased at 48 h and 72 h post-exercise in both groups (p<0.05). No significant differences were determined in serum myoglobin levels between groups (p>0.05). Changes in hs-CRP levels were found similar in both groups, and there were no significant differences between groups (p>0.05) (Table 3).

Discussion

This is the first randomized controlled trial directly comparing the timewise effect of KT on relieving DOMS. The present study demonstrated that KT intervention following the intense exercise protocol reduced muscle soreness. However, KT failed to accelerate the restoration of muscle strength and vertical jump height. No effect of KT on the time-course of serum LDH, myoglobin, and CRP levels was observed along the 72h recovery period. Additionally, KT may negatively affect the muscle damage with increasing CK level.

The mechanism surrounding muscle soreness following an intense exercise is not well understood, it seems likely to be related to inflammation, particularly to the connective tissue elements that sensitise nociceptors in muscle and hence increase sensations of pain.22 Previous studies demonstrated that muscle soreness was increased and peaked at 48 h after the exercise, and decreased after then.2,13,22 Cheung et al.2 reported that one of the reasons why DOMS pain reaches a maximum value within 48 hours is the increase in the permeability of the muscle cell membranes via creatine kinase levels as a result of muscle damage. Similarly, in the present study, muscle soreness increased immediately post-exercise, peaked at 48 h post-exercise in both groups, and decreased after that. There is conflicting evidence regarding the effects of KT on muscle soreness. According to Shoger et al.23 KT did not reduce the pain associated with
DOMS in the wrist flexors. Ozmen et al.\textsuperscript{11} also reported that KT application immediately before squat exercise had no effect on muscle pain. In contrast to these studies, Lee et al.\textsuperscript{10} found that KT alleviate muscle soreness by improving muscle strength and function compared with a control group at 24, 48, and 72 hours after eccentric exercise. Haksever et al.\textsuperscript{12} also showed that KT following eccentric fatigue training reduced DOMS pain on the 2nd and 7th days. In the present study, the muscle soreness level was similar immediately post-exercise in both groups, the decrease in the muscle soreness was greater and started earlier in post-exercise measurements in the KT group. This result suggests that KT was effective in reducing the muscle soreness. There were two reasons to explain the decreased perception of muscle soreness resulting from KT. First, KT stimulated the golgi tendon organ and triggered autogenic inhibition. Second, the increase in metabolic activity resulting from muscle contractions was effective in reducing muscle soreness.\textsuperscript{10,12} The decrease in muscle soreness may be a result of KT affecting subjective pain perception.

The decrease in muscle strength and function following intense exercise might be due, in part, to the protective mechanism of pain and inflammatory response.\textsuperscript{24} Previous studies have reported that muscle strength decreased immediately-post exercise and it continued to decline for several days as an indirect evidence of muscle damage.\textsuperscript{13,18} In the present study, the quadriceps muscle maximal isometric strength decreased immediately-post exercise in both groups. Even though it increased between 48 h and 72 h post-exercise in the KT group, muscle weakness was present at 72 h post-exercise in both groups. Several studies reported that KT improved muscle strength by reducing muscular tension and refining muscle alignment.\textsuperscript{10,12} Lee et al.\textsuperscript{10} found that KT was an efficient and faster method of recovering muscle strength than resting alone in adults with DOMS. Haksever et al.\textsuperscript{12} also reported that KT application with muscle facilitation technique following eccentric fatigue training improves muscle strength. On the other hand, Aminaka et al.\textsuperscript{25} shown that KT did not improve the muscle
activity and performance during recovery from DOMS. The result of the current study showed that KT had no significant effect on the quadriceps muscle strength over the 72h period following intense exercise. It would seem that differences between our findings and Haksever et al.\textsuperscript{12} might lie largely with the kinesiotaping technique. Haksever et al.\textsuperscript{12} chose KT application with muscle facilitation technique whereas the current study applied KT with fan technique. Additionally, previous work demonstrating an increase of muscle strength following KT application did not measure the serum CK level. It is estimated that despite the decrease in muscle soreness in this study, there was no effect of KT on muscle strength based on increasing CK level.

Many studies have observed that muscle soreness causes a reduction in vertical jump height immediately post-exercise.\textsuperscript{13,18} In this study, the decrease in vertical jump height started the immediately-post exercise in the placebo KT group. However, the reduction in vertical jump height started at 48h post exercise in the KT group. Vertical jump height also increased between 48h and 72h post-exercise in the KT group. Dr. Kase\textsuperscript{8} proposed that KT stimulated the mechanoreceptors of the skin and increased circulation. In this way, the KT may eliminate edema in muscle caused by strenuous exercise, especially with eccentric contraction, and may improve muscle performance. Conversely, Ozmen et al.\textsuperscript{11} shown that KT application immediately before squat exercise had no effect on short sprint performance. Nakajima et al.\textsuperscript{26} also reported that KT application had no effects on vertical jump height. According to Nakajima et al.\textsuperscript{26}, one possible explanation for these findings is that the tactile input from the KT is not strong enough to increase muscle power to influence vertical jump height. The results of the current study found no significant influences of KT on vertical jump height. Based on the increase of serum CK level, it is possible to assume that KT has no effect on both muscle strength and vertical jump performance.
Serum CK, myoglobin, and LDH are widely accepted as markers of exercise-induced muscle damage. Previous studies reported that, while the serum CK level peaked at 48 h after exercise, myoglobin and LDH levels peaked immediately after exercise. In the current study, as the serum CK and myoglobin levels increased immediately post-exercise, the serum LDH level did not change during this period. These results indicate that this exercise protocol is sufficient to create a muscle damage. CK is one of the muscle proteins that leak into the interstitial spaces by the lymphatic system, following eccentric exercise. Kim et al. investigated the effect of the duration of KT application on markers of muscle damage following eccentric exercise. They reported that CK activity was lower in the KT-24 hour group than in the KT-post-exercise group. On the other hand, Aminaka et al. found that KT did not improve the serum CK level, muscle activity and performance during recovery from DOMS. In the present study, KT increased serum CK levels at 72 h post-exercise, which may indicate an increased inflammatory response. Myoglobin is a muscle protein that leaks into the circulation after eccentric exercise. Like CK activity, myoglobin levels are closely related to the changes in permeability of cell membrane. Schillinger et al. reported an experimental group that had undergone manual lymph drainage after treadmill exercise and showed significantly reduced LDH and aspartate aminotransferase activities when compared with the control group. This study demonstrated no significant differences in myoglobin and LDH concentration levels at all time periods with KT application compared to placebo KT. Several studies investigated the hs-CRP level after eccentric exercises and reported no change in hs-CRP. In the present study, the hs-CRP level was investigated, and no change in the level of hs-CRP was observed post-exercise, and no differences were found between groups. Whilst there was no difference in myoglobin, LDH and hs-CRP level, the most notable finding is that increase in serum CK level in KT group at 72 h post-exercise. Such changes may be related to secondary damage due to intensive exercise, but it is not clear whether the secondary damage
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rapidly facilitated those markers. Further studies are needed to clarify the exact mechanisms of KT on muscle damage markers.

One limitation of the present study was that interventions and measurements were followed only 72 h post exercise-induced muscle damage, and full recovery from exercise-induced muscle damage was not monitored. Another limitation was the lack of blinded assessment, which should be observed in clinical trials with KT.

Conclusion

Further, to our knowledge, this is the first randomized, placebo-controlled study investigating the effects of KT on DOMS. The present study revealed that KT might help reduce muscle soreness after intense exercise. However, it has no effect on maximal quadriceps isometric strength and vertical jump height, as well as the serum LDH, myoglobin, and CRP levels. Furthermore, KT application after intense exercise increases the serum CK level.
REFERENCES


Figure 1: CONSORT flow diagram of study subjects.
Figure 2: Application of Kinesio-tape (A) Kinesio-taping; (B) Placebo kinesio-taping
Table 1: Demographic characteristics of subjects.

<table>
<thead>
<tr>
<th></th>
<th>KT (n=27)</th>
<th>Placebo KT (n=27)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (Male/Female, n)</td>
<td>14/13</td>
<td>14/13</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>21 (20-28)</td>
<td>22 (20-28)</td>
<td>0.11</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>1.70 (1.57-1.85)</td>
<td>1.70 (1.61-1.88)</td>
<td>0.73</td>
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<tr>
<td>Body weight (kg)</td>
<td>62 (50-107)</td>
<td>64 (47-90)</td>
<td>0.89</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.23 (18.34-31.26)</td>
<td>22.36 (16.85-29.05)</td>
<td>0.87</td>
</tr>
</tbody>
</table>

All values are presented as median (minimum-maximum)

KT: Kinesio-taping
Table 2: Comparison of the muscle soreness, quadriceps strength and vertical jump height in KT and Placebo KT groups.

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Groups</th>
<th>Pre-</th>
<th>Immediately Post-</th>
<th>48 h post-</th>
<th>72 h post-</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle soreness (mm)</td>
<td>KT</td>
<td>0 (0-0) a</td>
<td>30 (0-60) b</td>
<td>40 (0-80) b</td>
<td>10 (0-20) a</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Placebo KT</td>
<td>0 (0-0) a</td>
<td>30 (0-70) b,c</td>
<td>40 (10-80) b</td>
<td>20 (0-60) c</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.10</td>
<td>.84</td>
<td>.58</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>Quadriceps strength (N)</td>
<td>KT</td>
<td>264.9 (159.4-326.5) a</td>
<td>203.2 (120.1-320.8) b,c</td>
<td>199.6 (119.3-312.1) b</td>
<td>231 (128.3-343.5) c</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Placebo KT</td>
<td>246.7 (119.6-400.5) a</td>
<td>200 (24.8-397.1) b</td>
<td>203.9 (98.3-347.1) b</td>
<td>219.7 (99.5-372.4) b</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.84</td>
<td>.32</td>
<td>.89</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>Vertical jump height (cm)</td>
<td>KT</td>
<td>37 (24.3-60.3) a</td>
<td>31 (21-57) a,b</td>
<td>30.3 (21-53) b</td>
<td>31.3 (22.3-58.6) c</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Placebo KT</td>
<td>31.6 (23-56) a</td>
<td>28.3 (20.6-51.3) b</td>
<td>28 (20.6-53.6) b</td>
<td>28 (18.3-54.6) b</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>.54</td>
<td>.50</td>
<td>.62</td>
<td>.40</td>
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</tr>
</tbody>
</table>

All values are presented as median (minimum-maximum)

KT: Kinesio-taping

a,b,c Different letters within the same row indicate significant difference

* Mann-Whitney U test

* Friedman test
Table 3: Comparison of biochemical markers in KT and placebo KT groups.

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Groups</th>
<th>Pre-</th>
<th>Immediately Post-</th>
<th>48 h post-</th>
<th>72 h post-</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KT</td>
<td>107 (46-217) a</td>
<td>127 (59-231) b, c</td>
<td>147 (73-300) b</td>
<td>130 (86-267) c</td>
<td>&lt;.001</td>
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<td>CK (U/L)</td>
<td>Placebo KT</td>
<td>78.5 (34-229) a</td>
<td>103 (41-243) b</td>
<td>110.5 (32-303) a, b</td>
<td>105.5 (44-320) a, b</td>
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<td>p#</td>
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<td>.200</td>
<td>.093</td>
<td>.012</td>
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<td>KT</td>
<td>193 (149-226) a, b</td>
<td>205 (158-344) a</td>
<td>178 (127-354) b</td>
<td>173 (148-249) b</td>
<td>.032</td>
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<td>LDH (U/L)</td>
<td>Placebo KT</td>
<td>181 (123-303) a</td>
<td>196 (131-290) a</td>
<td>181 (127-266) a, b</td>
<td>165 (127-229) b</td>
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<td>p#</td>
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<td></td>
<td>KT</td>
<td>28.2 (17.2-52.7) a</td>
<td>67.3 (25.6-250.3) b</td>
<td>31.3 (17.5-70.6) a</td>
<td>27.5 (17.1-67.8) a</td>
<td>&lt;.001</td>
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<td>Myoglobin (ng/mL)</td>
<td>Placebo KT</td>
<td>28.5 (18.1-50.4) a</td>
<td>54.5 (27.7-186.1) b</td>
<td>29.4 (18.1-52.5) a</td>
<td>27.3 (2.8-71.4) a</td>
<td>&lt;.001</td>
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<td>p#</td>
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<tr>
<td></td>
<td>KT</td>
<td>0.1 (0.0-0.3)</td>
<td>0.1 (0.0-0.3)</td>
<td>0.1 (0.0-0.7)</td>
<td>0.0 (0.0-0.5)</td>
<td>.080</td>
</tr>
<tr>
<td>hs-CRP (mg/dL)</td>
<td>Placebo KT</td>
<td>0.1 (0.0-1.6)</td>
<td>0.1 (0.0-1.8)</td>
<td>0.1 (0.0-7)</td>
<td>0.1 (0.0-0.6)</td>
<td>.338</td>
</tr>
<tr>
<td></td>
<td>p#</td>
<td>.620</td>
<td>.543</td>
<td>.195</td>
<td>.301</td>
<td></td>
</tr>
</tbody>
</table>

All values are presented as median (minimum-maximum)

KT: Kinesio-taping, CK: creatine kinease, LDH: lactate dehydrogenase, hs-CRP: high sensitive C reactive protein

abc Different letters within the same row indicate significant difference

*Mann-Whitney U test

* Friedman test