A Quantitative Evaluation of Delayed Onset Muscular Soreness According to Application of Kinesio Taping

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Abstract. This study aimed to quantify the effects of kinesio taping on delayed onset muscular soreness (DOMS). Thirty-three normal subjects who underwent DOMS resulting from eccentric exercise of the biceps brachii were randomly assigned to group I (sham taping group, n=17) and group II (kinesio taping, n=16). Taping was conducted in the same direction as that of muscle fiber running. Comparison was made after measurement was taken four times (prior to the inducement of soreness, 24 hours, 48 hours, and 72 hours after inducement of soreness). According to comparison of changes in thermal pain threshold, there was swift and significant decrease in cold pain threshold and hot pain threshold of group II compared to group I (p<0.001). The effect of kinesio-taping applied to DOMS was verified using the quantitative evaluation method.

Keywords: Quantitative Evaluation, Delayed Onset Muscular Soreness, Kinesio Taping

1. Introduction

Delayed onset muscle soreness (DOMS) is triggered when the fast twitch fiber is damaged due to unaccustomed eccentric exercise[1]. DOMS begins 12 to 24 hours after the exercise and reaches the highest level 48 to 72 hours after the exercise. Swelling, dull pain, and decreased muscle strength, and muscular spasticity influence activities of daily living [2]. A diversity of research has been proceeded with on DOMS. Among different methods to treat DOMS, kinesio-taping enhances motor function of the muscles, thereby reducing pain[3] and improving muscle strength, muscle endurance, and muscle power[4]. However, it is difficult to quantify DOMS with the currently used tools and methods[5]. Visual analog scale (VAS) is mostly used[6] but it is a subjective evaluation method and therefore analysis of the result involves ambiguity. Accordingly, this study is meaningful in that it provided objective data by quantifying the effect of kinesio-taping on DOMS using objective equipment.
2. Subjects and Methods

2.1 Subjects
This study randomly assigned 33 subjects who underwent DOMS among 40 healthy male adults to group I (sham taping, n=17) and group II (kinesio taping, n=16). The criteria for inclusion as the subjects were: those who had no restriction to joint movement; those who had not regularly conducted exercise for the past three months; those who had no open wound or inflammatory disease in the measured area; and those who had not taken medication affecting the experiment. All the subjects voluntarily consented to participate in this study.

2.2 Methods to induce DOMS
A dumbbell weighing 60% of 1 repetition maximum was used to induce DOMS to the biceps brachii of the non-dominant arm. The subjects conducted eccentric exercise five sets with fifteen times as one set. A resting time of 60 seconds was given at intervals.

2.3 Evaluation Tool and Method
A TSA-2001 thermal sensory analyzer (Medoc Inc. Ramat Ishay, Israel) was employed in order to examine changes in objective pain threshold. The central area of the muscle belly was measured with the subjects in a sitting position and fully extending the elbow joint. Measurement was taken three times and the average value was used for analysis. The subjects took a rest for one minute between measurements. VAS was used to examine changes in subjective pain. Measurement was taken four times: prior to inducement of DOMS, 24 hours, 48 hours, and 72 hours after inducement of DOMS.

2.4 Data analysis
SPSS 18.0 Window version was used for data analysis. A repeated measures analysis of variance was carried out in order to analyze changes according to the time of measurement. A statistical significance level was set at $\alpha=0.05$. 
3. Results

3.1 Changes of thermal pain threshold (TPT)

After artificial inducement of DOMS, kinesio-taping was applied and thermal pain threshold (TPT) was measured at each measurement time point; There were significant differences according to the measurement time point in all the groups (p<0.001). Pain decreased from 24 hours after inducement of DOMS in group II (Table 1).

<table>
<thead>
<tr>
<th></th>
<th>-24h(a)</th>
<th>24h(b)</th>
<th>48h(c)</th>
<th>72h(d)</th>
<th>P</th>
<th>post-hoc contrasts</th>
</tr>
</thead>
<tbody>
<tr>
<td>group I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPT</td>
<td>16.15±2.25</td>
<td>5.95±2.83</td>
<td>7.49±2.94</td>
<td>8.86±2.21</td>
<td>&lt;.001</td>
<td>ab,ac,ad</td>
</tr>
<tr>
<td>WPT</td>
<td>38.63±3.14</td>
<td>29.6±3.28</td>
<td>28.56±3.35</td>
<td>30.19±3.57</td>
<td>&lt;.001</td>
<td>ab,ac,ad</td>
</tr>
<tr>
<td>group II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPT</td>
<td>15.79±1.61</td>
<td>7.07±3.21</td>
<td>10.57±2.44</td>
<td>14.35±2.60</td>
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<td>ab,ac</td>
</tr>
<tr>
<td>WPT</td>
<td>39.17±2.81</td>
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<td>33.83±4.21</td>
<td>38.99±3.76</td>
<td>&lt;.001</td>
<td>ab,ac</td>
</tr>
</tbody>
</table>

All Values showed mean±S.D.
-24h: 24 hours prior to DOMS, 24h: 24 hours after DOMS, 48h: 48 hours after DOMS, 72h: 72 hours after DOMS, CPT: Cold Pain Threshold, WPT: Warm Pain Threshold, ab:-24h*24h, ac:-24h*48h, ad:-24h*72h by repeated measure ANOVA

3.2 Changes of VAS

The measurement result of VAS according to measurement time point was that there were significant differences in all the groups and there was decrease in VAS from 24 hours after inducement of DOMS in group II (p<0.05)(Table 2).

<table>
<thead>
<tr>
<th></th>
<th>-24h(a)</th>
<th>24h(b)</th>
<th>48h(c)</th>
<th>72h(d)</th>
<th>P</th>
<th>post-hoc contrasts</th>
</tr>
</thead>
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<td>5.30±1.41</td>
<td>5.76±0.76</td>
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<td>group II</td>
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<td>4.98±1.59</td>
<td>5.66±0.46</td>
<td>2.10±0.98</td>
<td>&lt;0.01</td>
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</tr>
</tbody>
</table>

All Values showed mean±S.D.
-24h: 24 hours prior to DOMS, 24h: 24 hours after DOMS, 48h: 48 hours after DOMS, 72h: 72 hours after DOMS, ab:-24h*24h, ac:-24h*48h, ad:-24h*72h by repeated measure ANOVA

4. Discussion

DOMS releases chemical materials through inflammatory response. Therefore, afferent nerve fibers are activated delivering pain to the central nervous system [7].
Objective and specific evaluation is very important for the treatment of patients. However, pain is a very complex and subjective phenomenon and evaluation through objective approach is also difficult. Quantitative test is used to study functional abnormality and physiological characteristics of sensory receptors in relation to pain induced by stimuli[8]. Therefore, kinesio taping was applied to DOMS and pain decrease effect was evaluated using objective measurement equipment (TSA-2001) to look at usefulness of kinesio-taping.

Kinesio taping’s effect on changes in pain was examined according to measurement time. There were significant differences in the pain threshold from 24 hours after inducement of DOMS. According to a post hoc test, group II’s pain decrease was verified when warm pain threshold restored 72 hours after inducement of DMOS. This is considered because kinesio taping attached to the direction of running pulled the muscles, stimulated Golgi tendon organ, and triggered autogenic inhibition signals. In addition, it is regarded that promotion of metabolism resulting from inducement of muscle contraction was effective in reducing pain. The VAS result showed that there was swift pain decrease in group II. This means that taping affects subjective pain decrease.

Most prior research evaluated pain with subjective tools. On the contrary, this study examined pain change aspects by quantifying pain using TPT among the TSA-2001 programs. Such objective data is considered to be greatly meaningful as basic clinical data.

References