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Hsieh, Wei-Chi; Lin, Su-Hsien; Hsu, Hung-Chih; Wong, Alice May-Kuen; Siu, Ka-Kit; and Pei, Yu-Cheng (2006) "Effect of Kinesio Taping over Frontal Region on the Attention of Normal Subjects," Rehabilitation Practice and Science: Vol. 34: Iss. 4, Article 3.
DOI: 10.6315/2006.34(4)03
Available at: https://rps.researchcommons.org/journal/vol34/iss4/3

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“Kinesio taping” is a newly developed technique frequently used for the treatment of soft tissue lesions. The Kinesio Tex tape has the skin like elastic property and can be applied with tension at the soft tissue lesion site. This study was designed to assess the effectiveness of “Kinesio taping” on the attention in normal subjects. In several ways that can be used to assess attention, the well-known Posner paradigm was chosen. This paradigm can assess visual spatial attention by presenting the target participants with cues that direct attention to regions of the visual space within which an imperative stimulus may subsequently appear. The cue can be valid or invalid. After cuing, subjects press the left or right of computer mouse for response to the target participants appearing.

Twenty one healthy volunteers (17 males and 4 females) with aged from 21 to 27 years were recruited for this study. All subjects received Posner’s attention test with and without taping. The accuracy and the reaction time were analyzed. It was found that under the valid-cue condition, the reaction time was significantly delayed after “Kinesio taping” (p<0.05). It was concluded that the tactile effects of “Kinesio taping” might delay the reaction time under valid-cue condition. (Tw J Phys Med Rehabil 2006; 34(4): 215 - 223 )

Key words: visual attention, Kinesio taping, tactile stimulation

INTRODUCTION

“Kinesio taping” has been developed by Kenzo Kase in 1973.[1] This special technique has been widely used to control soft tissue pain and to facilitate the healing process after soft tissue injuries in several countries including America, Japan, Korea, Europe…etc (www.kinesiotaping.com). However, only a few scientific studies have been reported in the medical literature, and the topics were limited in the treatment of ankle lesion to facilitate proprioceptive function.[2-4]

“Kinesio taping” is a porous cotton fabric with a medical grade acrylic adhesive. It is thin like skin and can be stretched to 130%~140% of the original length. It allows a full range of motion for the applied muscles.  

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According to the official website of the “Kinesio taping” (www.kinesiotaping.com), the tapes can theoretically lift the skin to increase the space between the skin and muscle. This reduces the localized pressure and in turn helps the promotion of circulation, lymphatic drainage and lessens the irritation on the subcutaneous neural pain receptors. As a result, it reduces pain, swelling and muscle spasm; and subsequently promotes the body’s natural healing processes. Additionally, it may support fatigued, weakened and strained muscles.[1]

In our experience, some athletes have claimed that, after using “Kinesio taping” to treat their sports injuries, their performance in sports could be improved by enhancement of attention and proprioception. In our clinical observation, some patients who received taping therapy for tension headache also reported that their attention had been improved after taping over the frontal region.

In recent studies, it is generally believed that the operation of attention is based on a few interconnected components in human brain. These components include prefrontal, midfrontal, and posterior parietal cortices, as well as the anterior cingulate and the thalamus.[5] Traditionally, unimodal effect was regarded as mechanisms subserving attention, for which spatial attention were found in the contralateral somatosensory cortex for tactile attention, and in the contralateral occipital areas for visual attention.[6] However, recent results indicate that crossmodal interactions can also influence the activity in the cortical regions. Macaluso indicated that the links in spatial attention from touch to vision can affect the early stages of visual processing.[7] Macaluso also found that combining touch on one hand with visual stimulation in the anatomically corresponding hemifield could boost responses in contralateral visual cortex. He indicated that crossmodal influences of touch upon visual cortex depend on spatial alignment for the multimodal stimuli.[6] While it has not been possible to provide definite mechanisms of these interactions, these results identified a supramodal network for spatial attention between visual stimulation and cutaneous stimulation.

Based on the clinical observation of taping effects on attention and scientific evidences of the influence of tactile stimulation on visual attention, we designed this study to confirm the influence of “Kinesio taping” (tactile stimulation) on the attention in humans. In this study, visual spatial attention was evaluated before and immediately after the application of “Kinesio taping” on the frontal region.

MATERIALS AND METHODS

Subjects

Seventeen healthy male and 4 healthy female subjects with aged from 21 to 27 years were recruited from the medical students in the Department of Medicine of a university. Subjects with any neurological deficit or serious medical disorder were excluded from this study. This study was approved by the Institutional Review Board on Human Subjects Research in this university. All subjects signed the informed consent forms as approved.

“Kinesio taping”

We cut each section of skin-colored “Kinesio taping” with the length of 8.33cm, then stretched it to 10cm (120% of the original length) and taped it on the forehead of the participant symmetrically above the upper line of eyebrows (Figure 1). A cue was presented before the target in total the 240 trial. On half of the trials, the target appeared in the cued location; this defined as the valid cue condition. On the other half, the target appeared in the uncued location; this defined as the invalid cue condition. Half of the targets were presented in the right visual field (RVF) and half in the left visual field (LVF). On half of the trials, the target was presented 100 msec after the onset of the cue; on the other half, the target was presented 800 msec after the onset of the cue. The 100-msec delay condition allowed for the assessment of orienting and alerting prior to eye movement. The 800-msec condition allowed for the assessment of how well attention to a target location was maintained.[8] The different types of trials were presented randomly in each session.

Assessment of Attention

Each subject participated in two sessions of attention assessment with approximately 240 trials, including without taping and with taping immediately before the assessment. The sequence of the two sessions of assessment was randomized to reduce any training or learning effect.

Attention was assessed by the well-known Posner
paradigm by presenting the participants with cues that
direct attention to regions of the visual space within
which an imperative stimulus subsequently appeared.
Some researchers have proposed a model to determine the
covert shift of attention and sustained attention. To orient
to a particular spatial location by the covert shift of
attention, one’s attention must be (1) disengaged if it is
currently focused, (2) moved to the new location, and (3)
engaged at the new spatial location. Because the Posner
paradigm could be used to differentiate a covert shift of
attention and the sustained attention, we used it to exam-
ine the participants in this study.

The visual-spatial cueing tasks were implemented on
the Posner’s program. Two white boxes (1°×1° of
visual angle) were presented on a black background of the
computer screen. They were presented at about 5° of
visual angle from a central fixation cross (.6°×.6° of
visual angle), and this display remained for the entire
experiment. Each trial began with a cue event which was
the brightening of one of the two peripheral boxes,
followed by (either 100 msec or 800 msec after the onset
of the cue) a target which consisted of a white asterisk
(.5°×.5° of visual angle) inside one of the boxes. Meas-
ures were made under normal room illumination.

A detection response was required. Participants were
instructed to press the left key or right key on the com-
puter mouse with the index finger or middle finger of the
dominant hand when the target stimulus spot was pre-
sented either in the left or right side. If the stimulus
appeared within the location indicated by the cue (e.g. cue
points to the left and stimulus appears in the left visual
hemispace), the trial was considered to be “valid” (Figure
2). If the stimulus appears in a location that was not
indicated by the cue (e.g. cue points to the left but stimu-
lus appears in the right visual hemispace, or vise versa),
the trial was considered to be “invalid” (Figure 2). The
participants were informed that the target would be
preceded by a cue (300-msec brightening of one box,
caused by appearance of a double white line around the
box), but they should not respond to the cue. They were
also instructed to maintain their eyesight with center
fixation.

In the healthy participants, the valid cue oriented
attention to the target’s presentation and decreased reac-
tion time (RT), whereas the invalid cue orients attention
away from the target’s presentation and increased RT.
A trained technician sat directly behind each subject in
the experimental room to monitor participants’ attention
to the task. Trials on which participants made eye movements were not excluded from the analysis. All of the participants were given a practice session on the task before the experimental trials.

The practice sessions also served as training for the technician. RT was measured from the onset of the target to the onset of the key press. An error was recorded if the RT was less than 100 msec, and it was assumed to be an anticipation error or false alarm. If no RT occurred by 1500 msec after the target presentation, it was assumed to be an omission error. The target remained present until a response was made or for a maximum of 3 seconds. After the response, the target (asterisk) disappeared from the screen, and the two boxes remained on the screen for a 1000 msec inter-trial interval.[11]

Data analysis

For each of the 16 within-subject conditions [defined by the factorial combination of levels of taping (with and without), cue (valid and invalid), visual field (LVF and RVF) and delay (100 msec and 800 msec)], a mean RT was calculated based on the correct reactions for each participant. These means were based on the correct reactions from the cue presentations and the invalid cue presentations in each session. A four-way analysis of variance (ANOVA) was performed using four within-subject factors (taping, cue, VF, and delay). Statistical significant was set as p< 0.05.

Because the main effect could not be interpreted without the knowledge of interactions among the terms, we therefore followed analytic procedures recommended by Fisher,[12] which required a significant omnibus test to precede the simpler comparisons. The higher-order interactions were analyzed before the lower-order interactions, and the interaction effects were analyzed before the main effects. When interactions were significant, they were further analyzed as interaction contrasts at levels of the final factor. When interactions were non-significant, the main effects were analyzed. To avoid misinterpreting results due to an undetected higher-order interaction,[12] we completely decomposed the factorial matrix to describe the data fully. We specified when reported findings were the result of post-hoc planned comparisons (in which case appropriate corrections for multiple comparisons were noted if relevant) rather than the data decom-

position strategy. Post-hoc comparisons were performed using the Newman-Kuels procedure (α-level = 0.05). Analyses were preceded by the appropriate tests of the assumption of normal data distribution using the Kolmogorov-Smirnov test.[11] In addition, the presumption was not rejected. The statistical analysis was conducted using the Statistical Package for Social Science (SPSS Inc., Chicago, IL) for Windows.

RESULTS

Reaction Time

The mean reaction time of the 16 conditions defined by levels of cue, delay, visual field, and taping are presented in Table 1. The within-subjects effects to reaction time were analyzed as shown in Table 2. There were no significant difference between taping and non-taping (p=0.507). As we predicted, significant differences were found in delay (p<0.001), cue (p<0.001), and interaction between delay and cue (p=0.011). However, we found significant interaction between taping and cue (p=0.027), which might reveal the taping effects to the valid and invalid cueing conditions.

When the condition of cueing was considered, there were significant two-way interaction of taping with cueing condition. Figure 3 shows the reaction time (RT) of valid cue and invalid cue in the conditions of taping and non-taping. As shown in Figure 3, the mean RT at the condition of taping valid cue is with 10 msec longer than at non-taping valid cue, while the mean RT at the condition of invalid cue are the same. The interaction of cue and delay also reveals the similar gap difference as shown in Figure 4.

Accuracy

The mean accuracy of the 16 conditions defined by levels of cue, delay, visual field, and taping are presented in Table 3. As shown in Table 4, analyses of the within-subject effects to accuracy revealed no significant difference between taping and non-taping (p=0.123). Significant difference was found between valid cue and invalid cue (p=0.004). Besides, the cueing effects must be interpreted in light of the significant three-way interaction among taping, delay and cue (p=0.027).
Figure 3. Reaction time (RT) for conditions of valid or invalid cues, with or without taping.

Figure 4. Reaction time (RT) for conditions of valid or invalid cues with different onset.

Table 1. Reaction time of participants in different conditions

<table>
<thead>
<tr>
<th>Cue</th>
<th>Delay (msec)</th>
<th>Visual field</th>
<th>Reaction time (msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>Taping (+)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>Taping (-)</td>
</tr>
<tr>
<td>Valid</td>
<td>100</td>
<td>Right</td>
<td>320±20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>320±30</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>Right</td>
<td>300±30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>290±20</td>
</tr>
<tr>
<td>Invalid</td>
<td>100</td>
<td>Right</td>
<td>340±30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>340±20</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>Right</td>
<td>320±20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>330±30</td>
</tr>
</tbody>
</table>

Table 2. Tests of within-subjects effects to reaction time

<table>
<thead>
<tr>
<th>Factor</th>
<th>Degree of freedom</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taping</td>
<td>1</td>
<td>0.457</td>
<td>0.507</td>
</tr>
<tr>
<td>Delay</td>
<td>1</td>
<td>51.364</td>
<td>0.000*</td>
</tr>
<tr>
<td>VF</td>
<td>1</td>
<td>3.079</td>
<td>0.095</td>
</tr>
<tr>
<td>Cue</td>
<td>1</td>
<td>100.711</td>
<td>0.000*</td>
</tr>
<tr>
<td>Taping*Delay</td>
<td>1</td>
<td>1.104</td>
<td>0.306</td>
</tr>
<tr>
<td>Taping*VF</td>
<td>1</td>
<td>0.024</td>
<td>0.878</td>
</tr>
<tr>
<td>Delay*VF</td>
<td>1</td>
<td>0.301</td>
<td>0.589</td>
</tr>
<tr>
<td>Taping<em>Delay</em>VF</td>
<td>1</td>
<td>4.267</td>
<td>0.052</td>
</tr>
<tr>
<td>Taping*Cue</td>
<td>1</td>
<td>5.711</td>
<td>0.027*</td>
</tr>
<tr>
<td>Delay*Cue</td>
<td>1</td>
<td>7.920</td>
<td>0.011*</td>
</tr>
<tr>
<td>Taping<em>Delay</em>Cue</td>
<td>1</td>
<td>0.187</td>
<td>0.670</td>
</tr>
<tr>
<td>VF*Cue</td>
<td>1</td>
<td>1.523</td>
<td>0.232</td>
</tr>
<tr>
<td>Taping<em>VF</em>Cue</td>
<td>1</td>
<td>0.016</td>
<td>0.920</td>
</tr>
<tr>
<td>Delay<em>VF</em>Cue</td>
<td>1</td>
<td>5.170</td>
<td>0.034*</td>
</tr>
<tr>
<td>Taping<em>Delay</em>VF*Cue</td>
<td>1</td>
<td>2.515</td>
<td>0.128</td>
</tr>
</tbody>
</table>

VF: visual field; *p<0.05; *: interaction between or among variables
Table 3. Accuracy of participants in different conditions

<table>
<thead>
<tr>
<th>Cue</th>
<th>Delay (msec)</th>
<th>Visual Field</th>
<th>Taping (+)</th>
<th>Taping (−)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>100</td>
<td>Right</td>
<td>99±2</td>
<td>99±2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>99±1</td>
<td>99±2</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>Right</td>
<td>99±2</td>
<td>99±3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>99±1</td>
<td>99±2</td>
</tr>
<tr>
<td>Invalid</td>
<td>100</td>
<td>Right</td>
<td>99±3</td>
<td>94±9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>99±2</td>
<td>99±3</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>Right</td>
<td>98±4</td>
<td>99±2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>97±8</td>
<td>96±8</td>
</tr>
</tbody>
</table>

Table 4. Tests of within-subjects effects to accuracy

<table>
<thead>
<tr>
<th>Condition</th>
<th>Degree of freedom</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taping</td>
<td>1</td>
<td>2.599</td>
<td>0.123</td>
</tr>
<tr>
<td>Delay</td>
<td>1</td>
<td>0.066</td>
<td>0.800</td>
</tr>
<tr>
<td>VF</td>
<td>1</td>
<td>0.269</td>
<td>0.610</td>
</tr>
<tr>
<td>Cue</td>
<td>1</td>
<td>10.448</td>
<td>0.004*</td>
</tr>
<tr>
<td>Taping×Delay</td>
<td>1</td>
<td>3.769</td>
<td>0.066</td>
</tr>
<tr>
<td>Taping×VF</td>
<td>1</td>
<td>0.581</td>
<td>0.455</td>
</tr>
<tr>
<td>Delay×VF</td>
<td>1</td>
<td>6.655</td>
<td>0.018*</td>
</tr>
<tr>
<td>Taping×Delay×VF</td>
<td>1</td>
<td>3.169</td>
<td>0.090</td>
</tr>
<tr>
<td>Taping×Cue</td>
<td>1</td>
<td>1.231</td>
<td>0.280</td>
</tr>
<tr>
<td>Delay×Cue</td>
<td>1</td>
<td>0.007</td>
<td>0.935</td>
</tr>
<tr>
<td>Taping×Delay×Cue</td>
<td>1</td>
<td>5.730</td>
<td>0.027*</td>
</tr>
<tr>
<td>VF×Cue</td>
<td>1</td>
<td>0.016</td>
<td>0.901</td>
</tr>
<tr>
<td>Taping×VF×Cue</td>
<td>1</td>
<td>2.128</td>
<td>0.160</td>
</tr>
<tr>
<td>Delay×VF×Cue</td>
<td>1</td>
<td>7.975</td>
<td>0.010*</td>
</tr>
<tr>
<td>Taping×Delay×VF×Cue</td>
<td>1</td>
<td>3.021</td>
<td>0.098</td>
</tr>
</tbody>
</table>

VF: visual field; *p<0.05; ×: interaction between or among variables

DISCUSSION

The mechanism of therapeutic effects of “Kinesio taping” is unknown. A significant effect of applying white athletic tape to enhance the ankle proprioception has been documented.[4] Murray suggested that “Kinesio taping” may cause an increase in ankle proprioception through increased stimulation to cutaneous mechanoreceptors.[3] Contrarily, Halseth showed a negative result of the “Kinesio taping” in enhancing ankle proprioception.[2] However, no investigation has focused on the effect of enhancing attention after applying Kinesio tapping on the skin. If the skin irritation or the mechanical restrain provided by the tapping enhance the visual spatial attention, the athlete’s performance in sport will be advanced. In this study, the results indicate no significant differences in either reaction time or accuracy among taping and non-taping conditions. However, when the condition of cueing was considered, there were significant two-way interactions.
interaction of taping with cueing condition. The mean RT at the condition of taping valid cue was longer than at non-taping valid cue, while the mean RT at the condition of invalid cue was the same. Of great theoretical and practical importance, at the condition of non-taping, the gap of RT between valid cue and invalid cue was twice than the gap at the condition of taping, and the difference between the gaps was statistically significant. It is reasonable to consider that taping may have influenced the benefits of valid cue. The interaction of cue and delay also reveals the similar gap difference as shown in figure 4.

On the presupposition, Posner paradigm assesses covert shift of attention by trials of invalid cue. There are some studies about the attention operations that revealed dissociable components linked to specific neural systems.[10] The parietal lobe acts to release the attention (disengage) from its current focus and signals the midbrain to move the spotlight of attention from its current location to the area of the cue. The thalamus selects the contents of the attended area and enhances (engages) those contents so they are given priority for processing by anterior areas (sustained attention) that will detect targets and generate responses.[8] This pathway of covert-shift operation cause longer reaction time. However, in the condition of 100 msec delay, the benefit of valid cue was diminished due to insufficient time for early engaging. The results of taping showed similar effects of delay to RT, which indicates that taping might interfere with the operation of engaging.

Some recent studies showed the effects of somatosensory stimuli to spatial attention.[7,13-15] The frontal site was more active when the subjects attended to the visual stimulus and when the attention was divided, while the parietal site was more active during attention to the tactile stimulus and during simple sustained attention.[5] Kinesio taping applies pressure to, and stretch the skin can stimulate cutaneous mechanoreceptors which might arise tactile stimulus.[2] This concept underlies our hypotheses stating that the engage operation might be affected through increased cutaneous stimuli supplied by “Kinesio taping”.

In conclusion, the “Kinesio taping” dose not demonstrate a significant effect on visual-spatial attention in this study. As “Kinesio taping” is frequently used in reducing pain and soreness in athletes. It will be a benefit if the taping enhances the attention of the athletes, however, it will also be a demerit if with adverse effect. Together these data indicates that “Kinesio taping” would not promote the participants’ performance through enhancing attention, but might interfere with the engage operation. Despite the unclear mechanism of interaction between attention and exogenous stimulus, it is clear that much additional work will be required before completely understanding occurs. There are limitations of this investigation. First, the case number of 21 is too small to generalize the data to the population. Also, only 4 female subjects were included. In order to fully understand the effect of “Kinesio taping” on attention, further investigation will broaden the demographics in the subjects.

REFERENCES


前額肌內效貼紮對正常人注意力之影響

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嘉義長庚醫院復健科 長庚大學醫學系¹ 林口長庚醫院復健科²

肌內效貼紮(Kinesio taping)是一種新發展而經常被使用於治療軟組織傷害的技術。肌內效貼布具有相似於皮膚之彈性特質，可被施加張力而應用於軟組織之患處。本實驗的設計是為了評估肌內效貼紮對正常受測者注意力之影響。在眾多可評估注意力之方法中我們選用 Posner 的測試模式來進行本研究。此模 式可以以下方式評估受測者之視覺注意力：在電腦螢幕目標物出現之前，先以提示物的出現來提示目標 物出現的位置，但提示有可能是正確或是錯誤的。目標物出現時受試者以電腦滑鼠之左右鍵選擇目標 物出現的方向。

共有年齡從 21 到 27 歲之 21 位健康自願受測者(17 位男性，4 位女性)參與本實驗。每位受測者接受 前額肌內效貼紮與否，都各做一次 Posner 模式之注意力測試；用受測試者的反應時間及準確度來做分析； 我們發現在正確提示的情形下，接受貼紮之受測者的反應時間明顯變慢(P=0.027)。我們的結論是：肌內 效貼紮之觸覺刺激可能使得正確提示下受試者的反應時間變慢。（台灣復健醫誌 2006；34(4)：215 - 223）

關鍵詞：視覺注意力(visual attention)，肌內效貼紮(Kinesio taping)，觸覺刺激(tactile stimulation)