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Taping across the upper trapezius muscle reduces activity during a standardized typing task – an assessor-blinded randomized cross-over study

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Ethical approval for the study was obtained from the Medical Research Ethics Committee of the University of Queensland in Australia. The study was registered in the Australian New Zealand Clinical Trial Registry (ACTRN12612000074897). There was no funding in this study. The authors have no conflicts of interest to declare.
INTRODUCTION

Computer use often involves sustained postures of the head and shoulders and is associated with high cognitive and visual-load. Not surprisingly, office workers using computers often report symptoms in the neck region [Griffiths et al., 2012; Johnston et al., 2008]. As prolonged muscle activity even at low loads is associated with the development of upper extremity musculoskeletal disorders [Visser and Van Dieën, 2006], it is possible that increased activity in the upper trapezius (UT) muscle during and after typing work may be a source of neck pain in these workers. Various interventions have been investigated to reduce the activity in the UT muscle for the prevention and treatment of neck disorders such as muscle reeducation with biofeedback [Levanon et al., 2012; Voerman et al., 2007]. Another possible intervention is taping over the UT muscle [Huang et al., 2012; Morrissey, 2010]. Taping perpendicular to the orientation of the muscle fibers, with tension in the tape is advocated to inhibit its activity and is called inhibitory taping [Morrissey, 2000; 2010; Persson and Macdonald, 2010; Tobin and Robinson, 2000]. This effect was confirmed in a study of swimmers [Smith et al., 2009] where it was found that UT inhibitory taping resulted in a reduction of UT activity. It also resulted in an altered ratio of activity between the UT and lower trapezius (LT) muscles during swimming. This finding could reflect a better synergistic relationship between the two portions of the tripartite trapezius for the movement of the scapula/arm in a swimming stroke.

While inhibitory taping over the UT may influence the trapezius muscle during dynamic and high load tasks [Morin et al., 1997; Selkowitz et al., 2007; Smith et al.,
2009], it is unclear; 1) whether a similar effect is evident in the UT and LT muscles during a static, low load and functional activity such as a prolonged typing task, and 2) which of the UT and LT muscles is predominantly influenced by the UT inhibitory taping. If inhibitory taping of the UT reduces its activity in healthy individuals during a typing task, such a finding would provide the rationale for a comprehensive trial to investigate the preventative effect of UT inhibitory taping on neck and shoulder girdle symptoms in computer users.

The mechanisms underlying inhibitory taping are unclear but the tension of taping may be a potential contributor of the inhibitory effect. It is unknown whether the applied tension or the presence of the tape influences the activity in the UT muscle. We planned a study to answer this question by comparing the inhibitory effect on the UT muscle between taping conditions with and without tension. We hypothesized that the level of UT and LT muscle activity during a standardized typing task would be influenced by the tensioned tape. There would be no change in UT and LT activity in the non-tensioned tape and no-taping control conditions.

**METHODS**

**Design**

This study was an assessor-blinded randomized cross-over study with three interventions (tensioned taping, non-tensioned taping, and no-taping control). Each participant attended three sessions separated by at least three days to minimize the impact of the 15-minute typing task on muscle activity of the previous session (wash-out period). Therefore, block randomization (a block of six) was used.
Ethical approval for the study was obtained from the Medical Research Ethics Committee of the University of Queensland in Australia. All participants provided informed consent for their participation in this study.

Setting and Participants

Healthy individuals were recruited via advertising in the local community from May 2012 to July 2012. Inclusion criteria were participants of either gender aged 18 to 60 years, who used computers on a daily basis. Exclusion criterion included: 1) pain, discomfort or stiffness around the head, neck or shoulders, 2) history of trauma in the head, neck or shoulders, 3) allergies to adhesive tape.

In this study, a priori sample size estimation was conducted in the internal pilot study [Sandvik et al., 1996]. The estimation was performed with parametric statistics as a matter of statistical convenience with 12 participants in terms of the difference in the ratio of activity between the UT and LT muscles from a baseline 15-minute typing task (baseline typing task) to another 15-minute typing task with one intervention applied (intervention typing task) between the three conditions. The ratio was calculated from mean normalized root mean square values (RMS) to the maximum voluntary contraction (MVC) of both muscles (normalized UT/LT RMS ratio) [Marta et al., 2013; Moeller et al., 2014]. For the block randomization, G*Power 3 [Faul et al., 2007] demonstrated that 42 individuals were required to detect a significant difference between the three conditions (0.85 β and 0.05 α, 0.32 effect size f). Thus, an additional 30 participants were recruited to include 42 participants in total, as there was no change in methodology after the pilot testing.
Blinding and Intervention

Concealed allocation was maintained using sealed opaque envelopes. Participants selected an envelope with the order of the three intervention conditions. Participants were asked only to reveal their intervention condition to the researcher (HT) who applied and removed the tape. Another researcher (BD) who collected the muscle activity data was blinded to the three intervention conditions. This was achieved by covering the shoulder during each data collection period. To reinforce blinding, we used the terms, ‘mechanical taping’ instead of ‘tensioned taping’ or ‘inhibitory taping’, and ‘proprioceptive taping’ instead of ‘non-tensioned taping’, and informed participants that 'both the mechanical taping and proprioceptive taping might change the muscle activity in your shoulder and neck muscles' to exclude subjective bias for the effect of the taping type on the muscle activity. The electromyography (EMG) data were relabeled by the researcher (HT) to maintain blinding of the assessor for the purposes of analysis. Thus, assessor blinding was maintained throughout the study.

The researcher applying the taping was a physiotherapist with post-graduate qualifications in physiotherapy and experienced in using the inhibitory taping applied as recommended by Morrissey [2000]. Taping was applied to the dominant arm only without interfering with the surface electrode placement. For the tensioned taping, a 2-inch wide hypoallergenic adhesive underlay tape (Elastowrap, Beiersdorf, Hamburg, Germany) followed by a second layer of 2-inch wide rigid strapping tape (Elastoplast, Beiersdorf, Hamburg, Germany) was applied from the anterior aspect of the middle clavicle across the body of the UT muscle to approximately the level of the seventh rib
The second layer was applied with a 1.5-2.0 kg postero-inferiorly directed force monitored by a strain gauge transducer (WH-A05, Guangzhou Weiheng Electronics Co., Ltd., Guangzhou, Guangdong, China) (Figure 2). This amount of force was based on pilot testing with five different samples. In pilot testing the intervention, the researcher applied the tensioned taping several times consistent with the technique he routinely uses in clinical practice while blinded to the tension force created. The force ranged from 1.5 to 2.0 kg. For the non-tensioned taping, the same 2-inch wide hypoallergenic adhesive underlay tape was applied without tension in the same direction (Figure 1b).

**Outcomes**

The primary outcome measures included: 1) the mean RMS amplitude normalized to the MVC of the UT muscle (normalized UT RMS) and LT muscle (normalized LT RMS) and 2) the normalized UT/LT RMS ratio [Marta et al., 2013; Moeller et al., 2014] at the 15-minute baseline and intervention typing tasks. These three primary outcome measures were calculated using a custom developed MATLAB program (The MathWorks Inc, Natick, MA, USA).

The secondary measure was words per minute during the 15-minute typing task, which was recorded in the typing software, Bruce’s Typing Wizard software (Rozland Productions, Brooklyn, NY, USA). In addition, demographic information (age, gender, and weight and height to calculate the body mass index) and average time of computer use per day were recorded.
Processing of electromyography

Muscle activity was recorded using a portable EMG system (Porti, TMS international B.V., Oldenzaal, Overijssel, The Nederlands). The signals were amplified 20 times, band-pass filtered (10-500Hz), and digitized with 22-bit precision at 2048 samples/s (Portilab 2, international B.V., Oldenzaal, Overijssel, The Nederlands).

Following skin preparation, self-adhesive Ag/AgCl electrodes (Ambu Blue Sensor N-00-S, Ambu A/S, Baltorpbakken, Ballerup, Denmark) with a sensor area of 15mm² were attached on standardized positions for the UT and LT on the dominant arm with an inter-electrode distance of 20mm [Farina et al., 2002] (Figure 1). For the UT, the center of the electrodes was placed 20mm lateral to the midpoint of a line connecting the acromion and C7 spinous process to obtain the most repeatable signals [Jensen et al., 1993]. For the LT, the center of the electrodes was placed at 2/3 of the distance on the line from the trigonum spinea to the 8th thoracic vertebra. The ground electrode was placed on the C7 spinous process. Electrocardiography (ECG) data were also recorded using electrodes attached on the right side of the sternum and left side of the ribcage to exclude potential ECG artifacts from the EMG data. After excluding the potential ECG artifacts, EMG amplitude was obtained by calculating the root mean square of a 100ms sliding window.

ECG artifacts were removed with the following four steps using a custom developed MATLAB program [Takasaki et al., 2014]. First, each QRS complex was detected from the ECG signal. Second, ECG signals of ±6ms from the time of detected heartbeats were averaged to create the ECG artifact template. Third, the signal template was subtracted from the corresponding EMG signal at each heartbeat. Fourth,
EMG signals were band pass filtered between 20-500Hz with a 4\textsuperscript{th} order bi-directional Butterworth filter.

In each session, EMG normalization procedures were undertaken. The procedures included three MVCs for five seconds with a 2-minute rest between as recommended by Ekstrom et al [2005] in order to obtain the maximum signals. UT MVCs were conducted followed by LT MVCs. For the UT MVC, the participant sat upright on a treatment table, feet flat on the floor. The shoulder was abducted to 90\degree, the neck was side-bent to the side being tested, rotated to the opposite side and extended. Isometric manual pressure was applied simultaneously to the head and the elbow to maximally facilitate the UT [Ekstrom et al., 2005]. For the LT MVC, the participant lay prone with the arm abducted above the head in line with the muscle fibers of the LT. Isometric manual pressure was applied above the elbow [Ekstrom et al., 2005].

\textit{Typing task}

Data collection was undertaken in a laboratory setting. The workstation included a standard desk and a keyboard. Participants sat on a height-adjustable standard office chair without arm rests to allow the forearms to rest comfortably on the desk while typing. The hip, knee and elbow joints were approximately 90\degree. The computer monitor height was adjusted for each participant to enable them to assume an erect neck-head posture. The monitor height was consistent over the three sessions for each participant as the display height affects spinal muscle activity [Straker et al., 2008]. The keyboard was positioned directly in front of each participant. Participants were asked to copy-type at a comfortable pace and to ignore errors made, using Bruce’s Typing Wizard software.
where the document to be typed was displayed.

Data acquisition procedures

In each of the three sessions which were separated by at least three days, EMG normalization procedures using MVCs were performed. After a 5-minute rest period to minimize the impact of muscle fatigue on the typing task, the participants were given a few minutes to familiarize themselves with the typing software. The participant then performed the 15-minute baseline typing task followed by another 15-minute typing task with one intervention applied. These two typing tasks were separated by a 5-minute rest period.

Statistical Analysis

Data analysis

The Kolmogorov-Smirnov test confirmed that all data were not normally distributed. The logarithm or square root transformations did not improve data normality. Hence, non-parametric analyses were used for comparisons and median (minimum, maximum) was calculated.

The Friedman test was used as the primary analysis, to investigate the differences across the three intervention conditions for changes in the 1) normalized UT RMS, 2) normalized LT RMS and 3) normalized UT/LT RMS ratio during the intervention typing task from the baseline typing task. The two-tailed Wilcoxon signed-rank test with Bonferroni adjustments was used post-hoc to compare the difference between two conditions. In the post-hoc analysis, the effect size ($r$) (>0.5, large effect; 0.3-0.5,
medium effect; 0.1-0.3, small effect; <0.1, no effect) was calculated [Fritz et al., 2012]. The Friedman test was also used to consider baseline comparability between the three intervention conditions for each of the three primary measures in order to consider appropriateness of the wash-out-period.

As secondary analyses, words per minute made during the 15-minute typing task were analyzed using the Friedman test and the two-tailed Wilcoxon signed-rank test. Data of the baseline typing task was compared between the three sessions in order to consider the learning effect over sessions using the Friedman test followed by the two-tailed Wilcoxon signed-rank test with Bonferroni adjustments of two comparisons (between the first and second sessions, and between the second and third sessions) as post-hoc. The difference in the words per minute between during the baseline typing task and the intervention typing task was examined in each intervention condition using the two-tailed Wilcoxon signed-rank test, in order to consider consistency of effort during the typing task.

SPSS version 20.0 (IBM corporation, Armonk, NY, USA) was used for statistical analyses. The level of statistical significance was set at 5%.

RESULTS

Figure 3 depicts the flow of participants. Of the 56 who volunteered, 42 participants met the inclusion criteria. All participants completed the three sessions of measurements according to the pre-established methods. There were no negative effects of the taping reported by any participant throughout the study. Table 1 presents demographic data of the 42 participants.
Table 2 demonstrates values of normalized UT RMS amplitudes, normalized LT RMS amplitudes and normalized UT/LT RMS ratio at the baseline and intervention typing tasks and within session changes. The Friedman test revealed no significant difference in the baseline values between interventions in the UT RMS amplitudes \( [(2)=3.1, p=.21] \), in the LT RMS \( [(2)=1.48, p=.48] \) and in the UT/LT RMS ratio \( [(2)=1.7, p=.42] \). Regarding the changes from the baseline during each intervention condition, the Friedman test revealed a significant effect of interventions in the UT RMS amplitudes \( [(2)=7.2, p=.027] \), in the UT/LT RMS ratio \( [(2)=7.4, p=.024] \) but no effect in the LT RMS amplitudes \( [(2)=0.14, p=.93] \). The post-hoc analysis for the UT RMS amplitude change showed a significant difference between the tensioned taping and the no-taping control \( (p=.009, r=0.41) \), and between the non-tensioned taping and the no-taping control \( (p=.004, r=0.44) \). However, there was no significant difference between the tensioned taping and non-tensioned taping \( (p=.91, r=0.02) \). The post-hoc analysis for the UT/LT RMS ratio change demonstrated a significant difference between the non-tensioned taping and the no-taping control \( (p=.011, r=0.39) \). However, there was neither significant difference between the tensioned taping and non-tensioned taping \( (p=.92, r=0.02) \) nor tensioned taping and no-taping control \( (p=.018, r=0.37) \).

Table 3 demonstrates typing performance measures at the baseline and intervention typing task in each intervention condition. There was no significant difference within or between conditions (all \( p>.05 \)).

Table 4 demonstrates the UT RMS amplitudes, the LT RMS amplitudes, the UT/LT RMS ratio and the numbers of words per minute in the baseline typing task over the three sessions to examine the effect of order of intervention sessions. The Friedman
test revealed neither significant differences between the three sessions in the UT RMS amplitudes \((F)=4.1, p=.13\), in the LT RMS amplitudes \((F)=1.9, p=.40\) nor in the UT/LT RMS ratio \((F)=3.0, p=.22\). In contrast, the Friedman test revealed a significant effect of sessions on the number of words per minute \((F)=54, p<.001\). The post-hoc analysis showed a significant increase at the second session compared to the first session \((p<.001, r=0.82)\) and a significant increase at the third session compared to the second session \((p=.01, r=0.42)\).

**DISCUSSION**

This study investigated the effect of using UT inhibitory taping on the UT and LT activity during a typing task with three interventions (tensioned taping, non-tensioned taping, and no-taping control) applied. Our hypothesis was partially accepted as the activity of the UT was reduced not only in tensioned taping but also in non-tensioned taping compared with the no tape condition. The effect size of the reduction in RMS EMG amplitudes (inhibition effect) of the UT muscle was medium in each taping condition, supporting further research to investigate the impact of taping over the UT muscle for the reduction and/or prevention of neck and shoulder symptoms in computer users.

There were inconsistent findings for the changes in the UT RMS amplitudes and the UT/LT RMS ratio across the three intervention conditions, yet it appears that there was no difference in the inhibitory effect between tensioned taping and non-tensioned taping. This result suggests that any inhibitory effect may be due to the cutaneous input to the skin from the tape rather than hypothesized mechanical changes to the muscle.
length by tensioned taping [Morrissey, 2000]. Thus applying tape perpendicular to the
direction of the UT fibers may not be necessary to achieve a change in activity of the UT
muscle. The inhibitory effect of taping, regardless of direction, is further supported by
the findings of Huang et al [2012]. These researchers demonstrated that parallel taping
over the UT lowered UT activity during a typing task.

The lack of difference in the inhibitory effect between the tensioned taping and
non-tensioned taping for the UT may be associated with the nature of the static task of
typing. The tension to the skin created by either the tensioned taping or the non-
tensioned taping was likely to be consistent during the typing task as there was no
dynamic scapular movement in the task. Sensory information is attenuated when
sensory predictions accompanied by the motor command in the central nervous system
match actual sensory feedback and, therefore, we cannot tickle ourselves [Blakemore et
al., 2000]. Thus, the central nervous system might adapt to the automatic and
consistent sensory inputs from either the tensioned taping or the non-tensioned taping
during the typing task. Consequently, the difference in the magnitude of cutaneous
inputs from between the tensioned taping and the non-tensioned taping might be
attenuated, resulting in no difference in the inhibitory effect between the tensioned
taping and non-tensioned taping.

There were changes in the UT/LT RMS ratio but this was due to reduced EMG
amplitudes in the UT, as there was no change in activity of the LT muscle. Thus despite
an inhibitory effect on the UT, it is possible that there was no reciprocal impact on
reorganization within the subdivisions of the trapezius during a static typing task.
Reorganization within the subdivisions of the trapezius is seen when experimental pain
is induced in the UT muscle during a dynamic arm task [Falla et al., 2007]. Thus, taping over the UT may not alter the LT activity and the UT/LT ratio or alter them only in the presence of pain or during dynamic scapular movements. Further research will clarify this issue.

Words per minute typed during the 15-minute typing task did not alter within or between conditions. These findings indicate consistency of typing effort and no effect of fatigue or learning. The finding that taping did not alter productivity is a positive consideration when introducing any intervention in the workplace. The UT RMS amplitudes, the LT RMS amplitudes and the UT/LT RMS ratio in the baseline typing task were comparable over the three sessions (Table 4), indicating consistency of baseline measurements for the muscle activity. It suggests that the wash-out period was adequate, which is an important methodological issue in a cross-over design. In contrast, the number of words per minute typed gradually increased from baseline over the three sessions (Table 4), where effect size ranged from medium to large. This indicates a learning effect of the typing task, but using a randomization sequence minimized the impact of the learning effect in this study.

There are limitations in this study. First, it is not possible to perform absolute blinding of participants when no taping condition is included as a control. Furthermore, we attempted to reduce subjective bias of participants towards taping effects on muscle activity by rewording information provided to participants, suggesting both were active interventions. Nevertheless the placebo effect of taping cannot be eliminated. Second, this study investigated a typing task for 15 minutes as the effect of taping has been reported to be immediate [Morrissey, 2010]. However, it is possible that the muscle
response may differ during tasks of longer duration. This may be more evident in those with symptoms as observed by Karatas et al [2012], who demonstrated that parallel taping over the UT reduced neck discomfort in surgeons, who often demonstrate over activity of the UT [Szeto et al., 2010]. Third, although a priori sample size estimation was conducted, there is a possibility of a type II error because of the discrepancy in the statistical method (parametric or non-parametric) between the internal pilot study and the formal study. However, we interpreted the result using effect sizes as well as p-values. We believe that the impact of this potential limitation on the conclusion is negligible. Finally, this study used healthy subjects and the impact of taping may be different in the presence of pain. In particular, those with chronic neck pain may have altered central and peripheral sensitivity to sensory stimuli [Johnston et al., 2008; Neziri et al., 2013; Paulus and Brumagne, 2008; Stone et al., 2013]. Thus, further studies are required to confirm the inhibitory effect of taping in those with neck pain.

CONCLUSION

This study showed that both tensioned and non-tensioned taping across the UT muscle reduced its activity during a standardized typing task in healthy participants without interfering with typing performance. This study serves as a foundation for future studies to investigate the effect of taping on computer workers with neck pain towards finding simple and effective modalities to reduce and/or prevent work-related neck and shoulder discomfort. Such a future study will also be beneficial for individuals who perform prolonged monotonous occupational tasks.
ACKNOWLEDGMENTS

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Marta SMA, Pezarat-Correia PLC, Fernandes OJSM, Carita AI, Cabri JMH, de Moraes


CAPTIONS TO ILLUSTRATIONS

Figure 1. The tensioned taping and non-tensioned taping over the upper trapezius.

Figure 2. Setting for the application of the tensioned taping.

To monitor traction force in a posterior/inferior direction, the end of the clavicle side of the tape was attached to the strain gauge and the tape was attached on the upper trapezius (stripe). The scapular end of the tape and the attached part on the upper trapezius of the tape were pulled in a posterior/inferior direction (arrow) during the application of the tensioned taping. After applying the tape, the redundant portion from the upper trapezius to the attachment with the strain gauge was removed.

Figure 3. Flow of participants.
Figure 1

a. Tensioned taping

b. Non-tensioned taping
Figure 3

Included (N=56)

Excluded (n=14)
- Discomfort or stiffness around the neck (n=14)

Randomized (n=42)

Allocated to intervention order
- No taping → Tensioned taping → Non-tensioned taping (n=7)
- No taping → Non-tensioned taping → Tensioned taping (n=7)
- Non-tensioned taping → No taping → Tensioned taping (n=7)
- Non-tensioned taping → Tensioned taping → No taping (n=7)
- Tensioned taping → No taping → Non-tensioned taping (n=7)
- Tensioned taping → Non-tensioned taping → No taping (n=7)

Analyzed (n=42)
**TABLE 1.** Participant demographics (N=42).

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>38±11</td>
</tr>
<tr>
<td>Men</td>
<td>20 (48)</td>
</tr>
<tr>
<td>Women</td>
<td>22 (52)</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>22.0±4.3</td>
</tr>
<tr>
<td>Hours of computer use per day (hr)</td>
<td>4.8±3.1</td>
</tr>
<tr>
<td>Dominant arm left</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Dominant arm right</td>
<td>38 (90)</td>
</tr>
</tbody>
</table>

Values are presented with mean±SD or number (%).
**TABLE 2.** Median and interquartile range values of the mean root mean square (RMS) amplitude normalized to the maximum voluntary contraction of the UT (UT RMS amplitudes) and the LT (LT RMS amplitudes) and its ratio (UT/LT RMS ratio) at baseline and intervention measurements and within session changes.

<table>
<thead>
<tr>
<th></th>
<th>Baseline measurement (A)</th>
<th>Intervention measurement (B)</th>
<th>Changes (B-A)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UT RMS Amplitudes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensioned taping</td>
<td>2.12 (4.96)</td>
<td>1.59 (3.61)</td>
<td>-0.04 (0.91)</td>
</tr>
<tr>
<td>Non-tensioned taping</td>
<td>2.88 (3.72)</td>
<td>2.23 (3.70)</td>
<td>-0.39 (0.87)</td>
</tr>
<tr>
<td>No taping</td>
<td>2.47 (3.30)</td>
<td>2.00 (3.12)</td>
<td>0.04 (0.79)</td>
</tr>
<tr>
<td><strong>LT RMS Amplitudes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensioned taping</td>
<td>1.10 (1.07)</td>
<td>1.12 (1.17)</td>
<td>0.07 (0.61)</td>
</tr>
<tr>
<td>Non-tensioned taping</td>
<td>1.02 (1.34)</td>
<td>1.06 (1.23)</td>
<td>0.08 (0.49)</td>
</tr>
<tr>
<td>No taping</td>
<td>1.27 (1.34)</td>
<td>1.10 (1.52)</td>
<td>-0.01 (0.43)</td>
</tr>
<tr>
<td><strong>UT/LT RMS ratio</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensioned taping</td>
<td>1.89 (3.57)</td>
<td>1.37 (2.61)</td>
<td>-0.15 (1.05)</td>
</tr>
<tr>
<td>Non-tensioned taping</td>
<td>1.68 (3.66)</td>
<td>1.26 (3.10)</td>
<td>-0.29 (0.75)</td>
</tr>
<tr>
<td>No taping</td>
<td>1.39 (3.58)</td>
<td>1.81 (3.23)</td>
<td>0.04 (1.12)</td>
</tr>
</tbody>
</table>

Abbreviations: Upper trapezius, UT; Lower trapezius, LT.

Values are presented with median (interquartile range) values and mean±SD values are presented in Appendix 1.

*Primary measures compared in this study between the three intervention conditions.
**TABLE 3.** Comparisons within and between the three intervention conditions for words per minute.

<table>
<thead>
<tr>
<th></th>
<th>Baseline measurement</th>
<th>Intervention measurement</th>
<th>P-value (within each condition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensioned taping</td>
<td>48 (23)</td>
<td>49 (28)</td>
<td>.08</td>
</tr>
<tr>
<td>Non-tensioned taping</td>
<td>48 (25)</td>
<td>49 (25)</td>
<td>.06</td>
</tr>
<tr>
<td>No taping</td>
<td>49 (23)</td>
<td>50 (23)</td>
<td>.19</td>
</tr>
</tbody>
</table>

P-value (between the three conditions): .24 .38

Values are presented with median (interquartile range) values.
**TABLE 4.** Median and interquartile range values of the mean root mean square (RMS) amplitude normalized to the maximum voluntary contraction of the UT (UT RMS amplitudes) and the LT (LT RMS amplitudes) and its ratio (UT/LT ratio), and the numbers of words per minute in the baseline typing task over the three sessions.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT RMS Amplitudes</td>
<td>3.60 (5.29)</td>
<td>2.37 (3.08)</td>
<td>2.07 (3.55)</td>
</tr>
<tr>
<td>LT RMS Amplitudes</td>
<td>1.28 (1.20)</td>
<td>1.04 (1.08)</td>
<td>1.17 (1.36)</td>
</tr>
<tr>
<td>UT/LT RMS ratio</td>
<td>2.32 (3.77)</td>
<td>1.29 (4.13)</td>
<td>1.35 (2.44)</td>
</tr>
<tr>
<td>The numbers of words per minute</td>
<td>46 (23)</td>
<td>48 (23)</td>
<td>50 (25)</td>
</tr>
</tbody>
</table>

Abbreviations: Upper trapezius, UT; Lower trapezius.

Values are presented with median (interquartile range) values.
Hiroshi Takasaki is a lecturer in the Department of Physical Therapy at Saitama Prefectural University, Japan. He completed his PhD in Physiotherapy in 2013, receiving it from the University of Queensland (UQ), Australia. In 2013, he was also awarded a UQ post-doctoral research fellowship working within the NHMRC Centre of Clinical Research Excellence in Spinal Pain, Injury and Health. His research interests involve management for musculoskeletal pain, treatment based classification approach, and integration of biomechanical and neurophysiological research to the treatment based classification approach.
Blane is a physiotherapist who graduated from the University of Queensland with first class honours. Having gained exposure to overuse injuries working as an occupational injury management physiotherapist, Blane has developed a special interest in overuse injuries caused by industrial stresses and exercise.
Venerina Johnston is a senior lecturer in Physiotherapy, School of Health and Rehabilitation Sciences at The University of Queensland. Her research focuses on the prevention and management of musculoskeletal problems of the neck in the working population.
Abstract

Clinically, taping is believed to alter muscle activity. The purpose of this study was to investigate: 1) whether taping across the upper trapezius (UT) muscle influenced the level of UT and lower trapezius (LT) muscle activity and the ratio of these activities (UT/LT ratio) during a static typing task; and 2) if the activity of these muscles varied with the application of tensioned taping. Forty-two healthy participants performed a 15-minute typing task on three separate occasions under one of three conditions: taping applied perpendicular to the UT fibers with tension; taping without tension; and no taping. Activity of the UT and LT muscles was assessed using surface electromyography. Between conditions, significant differences were found in the change of the normalized amplitude in the UT activity (p=.027) and UT/LT ratio (p=.024) but not in the LT activity (p=.93). Compared with the no taping condition, the UT activity was less in both the tensioned taping (p=.009) and the non-tensioned taping (p=.004). There was no difference between the two taping conditions in the change of the UT (p=.91) activity and the UT/LT ratio (p=.92). In conclusion, both tensioned and non-tensioned taping across the UT muscle reduces its activity during a typing task.

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Key Words

electromyography; computers; neck muscle; orthotic tape