Efficacy of Kinesio Taping and Postural Correction Exercises on Levator Scapula Electromyographic Activities in Mechanical Cervical Dysfunction: A Randomized Blinded Clinical Trial

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ABSTRACT

Objective: Mechanical neck dysfunction (MND) is a major health burden. Although postural correction exercises (PCEs) are commonly used for its treatment, efficacy of Kinesio Taping (KT) has received considerable attention. This study was conducted to determine the effect of KT and PCEs on levator scapula (LS) electromyography.

Methods: Ninety-one patients with MND were randomly assigned into 1 of 3 groups that received 4 weeks’ treatment: group A, KT; group B, PCE; and group C, both interventions. Neck pain, LS root mean square (RMS), and median frequency (MDF) were measured pretreatment and post-treatment with the Numerical Pain Rating Scale and surface electromyography, respectively, by an assessor blinded to the patients’ allocation.

Results: Multivariate analysis of variance indicates a statistically significant group-by-time interaction (P = .000). Pain intensity was significantly reduced in group C more than in group B (P = .001). Mean values of RMS were significantly reduced in group C compared to both group A (P = .001) and group B (P = .022), whereas MDF was significantly increased in group C compared to either group A (P = .00) or group B (P = .026), and in group B compared to group A (P = .26). A paired t test revealed that there was a significant decrease in pain and RMS, and a significant increase in MDF in all groups (P < .01).

Conclusion: Application of both KT and PCE combined can significantly reduce neck pain and normalize LS activities in patients with MND more than the application of either intervention. (J Manipulative Physiol Ther 2020;43:588-596)

Key Indexing Terms: Cervical Pain; Exercise; Kinesio tape; Electromyography

INTRODUCTION

Despite medical development and growing knowledge pertaining to spinal disorders, mechanical neck dysfunction (MND) remains one of the most prevalent and costly health problems worldwide that has a complex etiology and many associated factors.1 Despite the high prevalence of this condition,2 a clear understanding of the cause and the identification of the best treatment strategies appears to remain a clinical enigma.3-5

This challenge may arise from focusing on pathoanatomy as an etiological factor of MND, ignoring the significant role of dysfunction. Neuromechanical studies have revealed that the functional consequences of activity involve interactions among neural, biomechanical, and environmental dynamics that give rise to meaningful motor behaviors.6 In the same regard, Murphy’s concept states that “pathoanatomy and dysfunction often interact to produce clinical symptoms.”7

For biomechanical dysfunction, adopting sustained non-neutral spinal postures with an increased muscle activation of the neck-shoulder stabilizers was reported to be
associated with MND. Patients with MND often assume forward head position in which the neck is thrust forward and upward away from the centerline of the body. The head bending moment increases applied pressure to the extensors, such as the semispinalis capitis and levator scapular muscles. Moreover, maintaining the extended position constantly to adjust the eye level causes fatigue in the muscles at the back of the neck.9,10

Previous studies have shown alterations in electromyographic (EMG) characteristics of axioscapular muscles in patients with MND, compared with healthy control participants. Altered axioscapular muscle function potentially contributes to neck pain owing to abnormal loading of the cervical spine or through the formation of myofascial trigger points. In contrast, pain may cause alteration in axioscapular muscle activities. Whatever the cause-and-effect direction, axioscapular muscle activities should be considered in the management of MND.

Some researchers have suggested that the amplitude of the myoelectric signal may provide some insight into the pain-spasm-pain (ie, vicious circle) theory of musculoskeletal dysfunction. Moreover, the decrease of median frequency in the EMG during tasks might be an indicator for fatigue of muscle fibers. Because the levator scapula (LS) muscle is suitable for surface EMG detection owing to its superficial location, it can be used to give rise to axioscapular muscle behavior.

Determining the most appropriate intervention for individuals with MND remains a priority for researchers. Among complementary and alternative treatments, exercise therapy may be considered as the most widely used conservative treatment. There has been a focus on postural correction exercises (PCEs), involving repeated cervical and scapular retractions, that has been proved to be effective and may be superior to general exercises for management of MND. This approach aimed at improving the neuromuscular control, strength, and endurance of the active subsystem stabilizing the spine. However, the recent reviews revealed that there is still a controversy regarding the evidence about the efficacy of PCEs for neck pain.

Kinesio tape (KT) is a thin elastic tape that can be stretched up to 130% to 140% of its original length, thereby providing a constant shear force on the skin. According to its creators, KT has beneficial effects and possible useful mechanisms to suppress pain, relax muscles, support joints, and improve circulation. Pain relief by KT has been reported in a number of previous studies involving different conditions, such as myofascial pain syndrome, acute whiplash, chronic low back pain, and mechanical neck pain. Although conflicting results are emerged from studies examining the effect of KT for MND, a further research is recommended focusing on the development of new predictions about its efficacy and/or combination of interventions.

The authors hypothesized that taping individuals in what is considered to be corrected posture using an inhibitory taping technique to provide biofeedback may interfere with muscular functions, thereby influencing MND. On the basis of this hypothesis, the aim of our study was to investigate the efficacy of kinesio taping and/or PCEs on LS EMG activities in the form of normalized root mean square (RMS) as an indication of muscle activation and median frequency (MDF) as an indication of muscular fatigue.

**METHODS**

This randomized controlled clinical trial was conducted in accordance with the 1964 Declaration of Helsinki and its later amendments, approved by the research ethics committee of the physical therapy college at Cairo University (P.T.REC/012/002167). It was registered (PACTR201511001266199). Participation was voluntary, and written informed consent was obtained from each patient before participating in the study.

**Participants**

Ninety-one patients from both sexes (48 female), age ranging from 20 to 35 years, referred by an orthopedist with a diagnosis of MND to physical therapy at the outpatient clinic of the Faculty of Physical Therapy, Cairo University. They all were either students or office workers. They were screened for eligibility criteria and received a standardized physical examination by an assessor blinded to patient allocation. Patients were instructed to avoid anti-inflammatory drugs for 72 hours before the study. Mechanical neck pain was defined as pain provoked by cervical posture, neck movement, or palpation of cervical muscles. A score above 15 on the Neck Disability Index indicates the presence of at least a mild neck pain disorder.

Exclusion criteria were contracture or surgery affecting the cervical spine, current participation in a supervised physical therapy program for neck pain or taking medications, and positive skin sensitivity test to kinesio tape. Also, patients were excluded when they had any defined pathology such as skin diseases, verteobasibular insufficiency, inflammatory diseases, neurologic diseases, congenital diseases, fractures, dislocations, neoplasms, and infection.

**Sample-Size Determination**

Calculations for sample-size determination were performed for neck pain as a primary outcome measure using G*Power (3.1) software. The calculations were based on 0.387 effect size (partial eta squared measured in our pilot study, which involved 21 patients assigned randomly and equally to 3 studied groups = 0.13), an alpha level of 0.05, a desired power of 90%, a numerator degree of
freedom of 2, and 3 experimental groups. The estimated desired total sample size for the study was 88 patients. To accommodate the expected dropouts before the study’s completion, a total of 91 participants were included in the study.

**Outcome Measures**

The primary outcome measure for this study was neck pain intensity measured by the Numerical Pain Rating Scale (NPRS), with LS EMG characteristics in the form of normalized RMS that reflects muscle activity and MDF that reflects muscle fatigue as secondary outcomes. The NPRS (range, 0 represented no pain and 10 represented maximum pain) is a reliable and valid tool for assessment of pain. The NPRS has a 1.3 minimal detectable change and 2.1 points for minimal clinically important difference.

The MyoSystem 1400A was used to measure LS normalized RMS and MDF. The sites of the electrode placement had been shaved when needed and cleaned by a piece of cotton with alcohol to reduce skin impedance. Electrodes sites were located on each participant’s dominant side as follows: The active electrode was placed lateral to the C3-4 spinous process between the posterior margin of the sternocleidomastoid and the anterior margin of the upper trapezius, and the reference electrode was placed over the C7 spinous process.

The raw EMG was amplified (bandwidth = 20-450 Hz, common mode rejection ratio >80 dB at 60 Hz, input impedance = 10 GΩ) and collected with a ±2.5 V range. The EMG signals of systemic bias were removed and full wave was rectified before being filtered. The resulting linear envelope signals were then normalized to maximal voluntary isometric contractions (MVICs). Assessment of the MVIC of the LS was performed as described by McLean; the participant was asked to laterally rotate his neck to the same side and perform a static shoulder elevation contraction against a manual resistance placed over the shoulder. Each contraction was maintained for 7 seconds and repeated 3 times against manual resistance with 30 seconds’ rest between the repetitions.

After assessment of the MVIC, participants were asked to write for 15 minutes; this task was chosen because it is the most common daily task for participants and it involves semistatic loads, which aggravate their symptoms. During the examination, positioning of the head, neck, shoulder, and spine were standardized to avoid their effect on the activities of the LS. Normalized RMS % was calculated (EMG amplitude during writing task/average of the 3 trials of [MVIC] × 100). Median frequency was calculated from the raw EMG signals.

All outcomes were collected at baseline and 4 weeks after the intervention by the same assessor who was blinded to the treatment allocation of the patients. Patients were blinded to their treatment allocation and uninformed of what intervention the other groups would receive.

**Allocation**

After the baseline examination, patients with eligibility criteria were assigned with simple randomization to receive kinesio taping (group A), PCEs (group B), or both (group C). A researcher, not involved in either recruitment or treatment of the patients, used a computer-generated randomized table of numbers created before the start of data collection for concealed allocation. Sequentially, individually numbered index cards, containing the randomly assigned intervention group, were folded and placed in opaque sealed envelopes. The envelope was opened by a second therapist blinded to baseline examination findings. The treatment proceeded according to the group assignment on the day of the initial examination.

**Interventions**

**Kinesio Taping.** The original kinesio tape was used (CK T85024). Before kinesio taping, a sensitivity test was examined; a small portion of the tape was applied on the inner part of the patient’s arm and kept for a day. The next day, the tape was removed and the patient was excluded if there was a reaction, then the tape was applied for patients whose sensitivity test was negative. Participants were seated in a chair in a standard neutral comfortable position. An inhibitory application technique was used. After exposing, shaving, and cleaning the taped part, the first layer of the tape was cut with a length equal to the distance from the T1-T2 spinous process to occiput into a Y-shape strip, keeping a base of 3 cm, and the edges were rounded.

Its base was applied on the T1-T2 spinous process without any tension. Then, each tail was applied over the posterior cervical extensor muscles in caudal-cephalic direction with a paper-off tension while the patient’s neck was in a position of maximum available cervical contralateral side bending and rotation. The paper-off tension tape is manufactured and applied to its paper backing with approximately 15% to 25% stretch. The ends were applied without any tension on upper cervical region C1-2.

The overlying I strip was an opened tape around 10 cm in length with rounded edges. It was applied perpendicular to the first one over the mid-cervical region (C3-C6), with moderate tension at the middle part and without any tension at the end, while the patient’s cervical spine was in the maximum available flexion to apply tension to the posterior neck structures (Fig 1). Finally, the applied Y and I strips were wrapped by the therapist’s fingers for 20 seconds. The tape was replaced every 4 days. This application technique has been used in previous studies.
Postural Correction Exercises. The participants were asked to sit naturally on a wooden stool with a flat and horizontal surface, with their hands resting on their thighs. The height of the stool was adjusted to ensure that their thighs were horizontal, parallel to the surface of the stool, and their feet were positioned at shoulder width and were well supported on the floor. Each exercise was performed as 3 sets of 10 repetitions, 2 times/wk for 4 weeks. Exercises were continued as a daily home program to influence the self-correction kinesthetic awareness.

Two main exercises were performed; the first one was cervical retraction for which each patient was asked to pull the head and neck into a position in which the head is aligned more directly over the thorax (chin in) while the head and eyes remain level (as if hiding behind a wall) for 10 seconds. The second exercise was scapular retraction, which was performed by asking each patient to take a deep inspiration and expand the chest then move the shoulders backward, bringing the scapulae together for 10 seconds. In addition to prospectively described exercises, patients were given home instructions regarding proper sitting, computer and telephone use, lifting, and reading to maintain neutral neck posture. This protocol was performed previously, but the combination of both modalities to perform the exercises while being taped had not been examined previously.31

Statistical Analysis

Reported data were analyzed using SPSS computer program version 24 for Windows (Charles R. Flint, New York) using an intention-to-treat analysis. When post-intervention data for 4 patients were missing, baseline scores were used. Potential differences in baseline demographic and clinical variables between groups were examined using 1-way analysis of variance.

Two-way multivariate analysis of variance was used to examine the effects of the treatment on pain intensity and levator scapula EMG characteristics (RMS and MDF). The variable of interest was the group-by-time interaction at an a priori alpha level of 0.05. A Bonferroni post hoc test was used to determine which group was superior when the interaction was significant. Individual paired t tests (2-tailed) for each group were done to determine the magnitude of changes within each group. All measurements were based on a 95% CI and 95% confidence level.

Results

One hundred and eight consecutive patients were screened for eligibility criteria. Ninety-one patients (mean ± standard deviation age, 27.31 ± 4.13 years; body mass index [BMI], 27.87 ± 3.22; 48 male) satisfied the eligibility criteria, agreed to participate, and were randomized to group A: kinesio taping (n = 30) (age, 27.23 ± 3.69 years; BMI, 27.82 ± 3.32; 17 male), group B (n = 31): posture correction exercises (age, 27.58 ± 4.28 years; BMI, 27.86 ± 3.16; 15 male), and group C (n = 30): Both modalities combined (age, 27.1 ± 4.51 years; BMI, 27.92 ± 3.29; 16 male). The reasons for ineligibility are found in a flow diagram of the patients’ recruitment and retention (Fig 2). There was no significant difference among groups for both demographic (age, sex, weight, height, BMI) and measured variables at baseline (Table 1).

Multivariate tests for outcome measures indicate a statistically significant group-by-time interaction (F = 4.46, P = .00) (Table 2). The univariate group-by-time interaction was statistically significant for the NPRS (F = 6.33, P = .002) and MDF (F = 5.28, P = .006), but there was no statistically significant group-by-time interaction for RMS (F = 2.23, P = .11). Post hoc tests revealed that mean values of the NPRS were significantly reduced in patients who received both modalities in group C compared to patients in group B, who received posture correction exercises (P = .001). Mean values of RMS were significantly reduced in group C compared to both group A (P = .001) and group B (P = .022), whereas MDF was significantly increased in
Fig 2. A flowchart of patient recruitment and retention. MND, mechanical neck dysfunction.

Table 1. Demographic and Baseline Features of the 3 Studied Groups

<table>
<thead>
<tr>
<th></th>
<th>Group A (n = 30)</th>
<th>Group B (n = 31)</th>
<th>Group C (n = 30)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>17 male and 13 female</td>
<td>15 male and 16 female</td>
<td>16 male and 14 female</td>
<td>.59</td>
</tr>
<tr>
<td>Age (y)</td>
<td>27.23 ± 3.69</td>
<td>27.58 ± 4.28</td>
<td>27.1 ± 4.51</td>
<td>.898</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.03 ± 8.25</td>
<td>73.5 ± 8.7</td>
<td>73.83 ± 7.11</td>
<td>.743</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.62 ± .055</td>
<td>1.63 ± .45</td>
<td>1.6 ± .028</td>
<td>.133</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.82 ± 3.31</td>
<td>27.86 ± 3.16</td>
<td>27.92 ± 3.29</td>
<td>.994</td>
</tr>
<tr>
<td>Pain intensity</td>
<td>6.07 ± 1.23</td>
<td>6.16 ± 1.09</td>
<td>6.13 ± 1.17</td>
<td>.949</td>
</tr>
<tr>
<td>LS RMS</td>
<td>17.59 ± 3.57</td>
<td>15.69 ± 5.01</td>
<td>15.11 ± 4.97</td>
<td>.097</td>
</tr>
<tr>
<td>LS MDF</td>
<td>54.73 ± 11.9</td>
<td>57.44 ± 8.64</td>
<td>58.27 ± 9.66</td>
<td>.372</td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD. P > .05 = not significant.

BMI, body mass index; LS, levator scapula; MDF, median frequency; RMS, root mean square; SD, standard deviation.
group C compared to either group A ($P = .00$) or group B ($P = .026$) and in group B when compared to group A ($P = .26$) (Table 3). A paired $t$ test revealed that there was a significant decrease in the mean values of NPRS and RMS and a significant increase in mean values of MDF in all groups ($P < .01$).

**DISCUSSION**

This study was conducted to examine the efficacy of kinesio taping and PCEs on pain intensity and LS EMG characteristics in the forms of normalized RMS as an indication of muscle activity amplitude and MDF as an indication of muscular fatigue. An increase of RMS and decrease of MDF were used as a proxy measure of MND. According to our results, although patients in all 3 groups displayed significant changes in their neck pain and EMG characteristics, patients who received combined modalities displayed a greater reduction in their neck pain and better restoration of the normal muscle activities compared with either patients performed postural exercises or taped patients who exceed the minimal clinically important difference.

There are a number of explanations for these findings. Neck pain is commonly associated with protective spasm in the surrounding muscles producing pressure within the muscles, thus developing ischemia, more pain, and abnormal neck posture. Especially because our patients were either students or office workers, they usually adopt a sustained non-neutral posture. This vicious cycle that can occur in reverse may be broken by relieving the pain, reducing the muscle spasm, or correcting the abnormal neck posture.1,17

The cutaneous stretch stimulation provided by KT may interfere with the transmission of mechanical and painful stimuli, as KT may provide afferent impulses inhibiting pain through gait control theory. Furthermore, KT may increase lymphatic and vascular flow, and aid in the correction of possible articular misalignments.22,26,38 Thus, it may improve the functional abilities of the patient.

**Table 2. MANOVA for All Dependent Variables at Different Measuring Periods Among Studied Groups**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>$F$ Value</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>8.06</td>
<td>.000 a</td>
</tr>
<tr>
<td>Measuring periods</td>
<td>246.5</td>
<td>.000 a</td>
</tr>
<tr>
<td>Interaction (group $\times$ time)</td>
<td>4.5</td>
<td>.000 a</td>
</tr>
</tbody>
</table>

MANOVA, multivariate analysis of variance.

a Significant at alpha level < .05.

**Table 3. Post-intervention, Within-Group, and Group-by-Time Interaction for Pain Intensity, Disability, UT RMS, and UT MDF**

<table>
<thead>
<tr>
<th>Variable and Group</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Within-Group Change</th>
<th>Group $\times$ Time Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$t$</td>
<td>$P$</td>
<td>MD (95% CI)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>($P$)</td>
<td>($P$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>6.07 ± 1.23</td>
<td>3.07 ± 0.87</td>
<td>13.99 .00 a 3 (2.56-3.44)</td>
<td>6.33 .002 a</td>
</tr>
<tr>
<td>B</td>
<td>6.16 ± 1.09</td>
<td>3.52 ± 0.89</td>
<td>14.95 .00 a 2.65 (2.28-3.01)</td>
<td></td>
</tr>
<tr>
<td>C$^{b}$</td>
<td>6.13 ± 1.17</td>
<td>2.23 ± 0.63</td>
<td>25.28 .00 a 3.9 (3.58-4.22)</td>
<td></td>
</tr>
<tr>
<td>LS RMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>17.59 ± 3.57</td>
<td>9.61 ± 2.96</td>
<td>10.25 .00 a 7.97 (6.38-9.56)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>15.69 ± 5.01</td>
<td>10.13 ± 2.67</td>
<td>5.74 .00 a 5.57 (3.59-7.55)</td>
<td></td>
</tr>
<tr>
<td>C$^{b}$</td>
<td>15.11 ± 4.97</td>
<td>7.11 ± 1.34</td>
<td>9.32 .00 a 7.99 (6.24-9.75)</td>
<td></td>
</tr>
<tr>
<td>LS MDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A$^{b}$</td>
<td>54.73 ± 11.93</td>
<td>69.28 ± 13.7</td>
<td>8.04 .00 a 14.55 (18.25-10.85)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>57.44 ± 8.64</td>
<td>76.15 ± 5.76</td>
<td>12.42 .00 a 18.7 (21.79-15.63)</td>
<td></td>
</tr>
<tr>
<td>C$^{b}$</td>
<td>58.27 ± 9.66</td>
<td>84.46 ± 8.06</td>
<td>13.09 .00 a 26.19 (30.28-22.09)</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD.

a $P < .05$ = significant.

b $P < .05$ = significant difference relative to groups B and C ($P < .05$).

LS, levator scapula; MD, mean difference; MDF, median frequency; RMS, root mean square; SD, standard deviation.
Although MND was found to be associated with altered muscular activities, KT may normalize muscle function through 2 main mechanisms. The first one is mechanical; taping influences the length of muscle fibers, inducing a shift of the length-tension curve of those muscles by changing the relative position of subsequent joints or directly by influencing the direction of muscle fibers. The second mechanism, proprioceptive, considers the amplification of kinesthetic information reaching the central nervous system through taping-induced cutaneous stimulation.

Regarding PCEs, frequent correction to an upright neutral posture may serve 2 functions. First, it may regularly reduce the adverse loads on the cervical joints induced by poor cervical and scapular postures. Second, it trains the deep postural stabilizing muscles of the spine in their supporting role. Performing these exercises repeatedly throughout the day may help participants develop a change in postural habits. Thus, we suggest that the effect may emerge because of neutral postural awareness, which relieves the tension causing pain.

We speculate that taping our patients continuously for 4 weeks may act as continuous analgesic stimulus on their neck muscles owing to the prospectively mentioned interaction between cutaneous receptors and pain. Furthermore, the neural feedback provided by KT facilitates the ability of the patients to move their cervical spine with a reduced mechanical irritation on the soft tissues, thus that improves the efficiency of PCEs, which may allow correction of postural imbalance.

There is a lack in the literature regarding studies that combine kinesio taping with PCEs for MND. However, the review conducted by Saracoglu et al concluded that the application of the scapular taping used in conjunction with a physical therapy program was shown to improve the outcomes in subacromial impingement syndrome. Also, Added et al suggested adding KT to a physical therapy program for mechanical low back pain, and Greenstein et al recommended the application of kinesio taping immediately after cervical manipulation.

**Limitations**

The duration of the interventions was 4 weeks to find the short-term effects. No follow-up was done to know the long-lasting effect and recurrence of symptoms. Another important limitation may be the heterogeneity related to the etiology of MND. Also, our patients were heterogeneous regarding their BMI; some of them were overweight and others were obese. However, there was no statistically significant difference between mean values of BMI in the studied groups. Further, all patients were treated by the same therapist. So, the generalizability of the results should be considered with caution. Additionally, it might be more helpful if the algometer was used to measure pain sensitivity of trigger points.

**CONCLUSION**

Application of both KT and a PCE program may be an alternative option in the treatment of MND. This combination may result in greater reduction in neck pain intensity and better normalization of axioscapular muscle functions than application of either KT or an exercise program separately.

**FUNDING SOURCES AND CONFLICTS OF INTEREST**

This research received no specific grant from any funding agency in the public, commercial, or medical for-profit sectors. Thus, the authors declare that there is no conflict of interest.

**CONTRIBUTORSHIP INFORMATION**

Concept development (provided idea for the research): A.M.E.
Design (planned the methods to generate the results): A.R.I., H.M.E.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): A.M.E., H.M.E., H.A.H.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): O.M.E., A.M.E.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): A.M.E., O.M.E.
Literature search (performed the literature search): H.A.H., A.R.I.
Writing (responsible for writing a substantive part of the manuscript): A.M.E.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): H.M.E., A.M.E.

**Practical Applications**

- Kinesiotape, when combined with PCEs, may result in more pain reduction and normalization of axioscapular muscle function.
- Levator scapula EMG characteristics may be used as an indication for axioscapular muscle functions.
- An increase of the RMS of muscular activities and decrease of MDF may be used as proxy measures for MND.
REFERENCES


