Hong Kong Physiotherapy Journal (2016) 35, 5–11

Available online at www.sciencedirect.com

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journal homepage: www.hkpj-online.com

RESEARCH REPORT

Effect of muscle energy technique and static stretching on pain and functional disability in patients with mechanical neck pain: A randomized controlled trial☆

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KEYWORDS
mechanical neck pain;
muscle energy technique;
neck disability index;
stretching;
visual analogue scale

Abstract *Background:* Mechanical neck pain is one of the common musculoskeletal disorders. Muscle energy technique (MET) may be a useful intervention for treating such disorder.
Objective: The aim of this study was to compare the effect of MET with passive stretching on pain and functional disability in people with mechanical neck pain.
Methods: A randomized controlled trial was undertaken. Sixty patients with mechanical neck pain were randomly allocated to either the MET group or control group. The former group received MET, and the latter group received static stretching. Both groups received conventional therapy. Treatment was given once a day for 6 days. A visual analogue scale (VAS) was used to measure the intensity of pain, and functional disability was assessed using the neck disability index (NDI) was immediately before treatment and again on the 6^{th} day.
Results: VAS and NDI scores showed a significant improvement in both MET and stretching groups on the 6^{th} day postintervention ($p < 0.05$). However, both VAS and NDI scores showed better improvement in the MET group as compared to the stretching group ($p < 0.025$).
Conclusion: Muscle energy technique was better than stretching technique in improving pain and functional disability in people with mechanical neck pain.
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☆ Clinical trial registry number CTRI/2015/02/005572.

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http://dx.doi.org/10.1016/j.hkpj.2015.12.002
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Introduction

Neck pain is one of the most common musculoskeletal disorders in the general population. Point prevalence ranges from 6% to 22% and up to 38% of the elderly population, while lifetime prevalence ranges from 14.2% to 71% [1]. The International Association for the Study of Pain defines neck pain as: "Pain perceived as arising from anywhere within the region bounded superiorly by superior nuchal line, inferior by an unoriginally transverse line through the tip of first thoracic spinous process, and laterally by sagittal plane tangential to the lateral border of neck" [2].

Mechanical neck pain is a generalized neck and/or shoulder pain with mechanical characteristics, including symptoms provoked by maintained neck postures, neck movement, or by palpation of the cervical muscles [3].The source of symptoms in mechanical neck pain is not completely understood, but has been purported to be related to various anatomical structures, particularly zygapophyseal or uncovertebral joints of the cervical spine [4]. A frequently seen cause of the neck pain is awkward occupational postures, anxiety, stress, heavy lifting, and physically demanding work [5].

Janda [6] described upper crossed syndrome as facilitation of the upper trapezius, levator scapulae, sternocleidomastoid, and pectoralis muscles, as well as inhibition of the deep cervical flexors, lower trapezius, and serratus anterior. These muscle imbalances and movement dysfunctions may have a direct effect on joint surfaces, thus potentially leading to joint degeneration. In some cases, joint degeneration may be a direct source of pain, but the actual cause of pain has been often secondary to muscle imbalance [7].

A wide variety of treatment protocols for mechanical neck pain are available. However, the most effective management remains an area of debate.

Both muscle energy technique (MET) and stretching are widely used techniques in the field of physiotherapy. MET is an advanced stretching techniques [7]. Studies using these two techniques individually in symptomatic as well as in asymptomatic population have shown improvement [8—12], but very few studies have compared these techniques in a symptomatic population, where conflicting results are seen [13—20]. A study done by Mahajan et al [17] compared these two treatment technique in patients with mechanical neck pain. There is lack of evidence to allow conclusions to be drawn about the effectiveness of MET when compared with stretching exercises for relieving mechanical neck pain. Therefore this study will add to the growing body of knowledge that if these two techniques yield comparable outcomes and if one technique is superior to the other, which should be the alternative choice of therapy. Therefore, the study was done to compare effect of MET when compared with passive stretching in reducing pain and functional disability in patients with mechanical neck pain.

Materials and methods

Participants

After receiving ethics clearance from the institutional committee of the Sancheti Institute College of Physiotherapy, 110 patients with neck pain were evaluated from April 2013 to October 2014 according to the following criteria: (1) age 18—50 years; (2) neck pain on visual analogue scale (VAS) 4—8 (moderate cases); and (3) subacute or chronic cases (4—12 weeks). Participants were excluded according to the following criteria: (1) signs of serious pathology (e.g., malignancy, inflammatory disorder, infection); (2) history of cervical spine surgery in previous 12 months; (3) history of trauma or fractures in cervical spine; (4) signs of cervical radiculopathy or myelopathy; and (5) vascular syndromes such as basilar insufficiency.

Sixty participants met these criteria. A written consent form was taken from participants and the procedure was explained by the investigator.

Randomization

Individuals who met the inclusion criteria were randomly allocated to Group A or Group B, using chit method without replacement. The allocation was conducted by the primary investigator prior to the baseline assessment. Group A underwent postisometric relaxation for upper trapezius and levator scapulae, whereas Group B received passive stretching technique for upper trapezius and levator scapulae.

Outcome measures

Pain and functional disability were assessed at the baseline and repeated at the end of intervention period i.e., on 6^{th} day.

Test—retest reliability of VAS has been shown to be good, but higher among literate ($r = 0.94$) than illiterate patients ($r = 0.71$) before and after attending a rheumatology outpatient clinic [21]. For construct validity, in patients with a variety of rheumatic diseases, the VAS has been shown to be highly correlated with a 5-point verbal descriptive scale (*nil*, *mild*, *moderate*, *severe*, and *very severe*) and a numeric rating scale (with response options from *no pain* to *unbearable pain*), with correlations ranging from 0.71 to 0.78 and from 0.62 to 0.91, respectively. The correlation between vertical and horizontal orientations of the VAS is 0.99 [21]. VAS is thus considered a reliable and valid tool for measuring the pain level.

The neck disability index (NDI) for measuring disability in patients with neck pain has a pivotal role in research and clinical settings and is interpreted to have good reliability [22,23].

Intervention

Group A: Postisometric relaxation technique was applied to upper trapezius and levator scapulae muscles for five repetitions using 20% of maximal isometric contraction. Stretch was held beyond resistance barrier for 20 seconds [7]. Group B: Passive stretching was applied to upper trapezius and levator scapulae muscles for five repetitions with 20 second hold [24].

Figure 1 shows the post isometric relaxation and stretching technique for upper trapezius muscle and Figure 2 shows the postisometric relaxation and stretching

Figure 1. Muscle energy technique and stretching technique for upper trapezius.

technique for levator scapulae muscle. According to Janda [6], upper trapezius and levator scapulae muscles are overactive due to muscle imbalances (upper crossed syndrome); hence, these muscles were targeted.

Both groups were treated with a conventional exercise programme, which included strengthening exercises for deep neck flexors, rhomboids, lower trapezius and serratus anterior because they are weak muscles in upper crossed syndrome (2 sets of 10 repetitions once a day) and stretching exercises for pectoralis muscles (20-second hold, 5 repetitions) [25,26]. Intensity of the exercise prescription was decided depending upon symptomatic response of the patients [27,28]. Commercially available hydrocollator packs were given over the painful area in cervical region before the treatment [17]. Temperature of the hydrocollator unit was set at 70°C and six to eight layers of the towel were set. It was given for 20 minutes [29]. Six sessions were given to each group. Participants were treated once daily for 6 consecutive days.

Figure 2. Muscle energy technique and stretching technique for levator scapulae.

Statistical analysis

The sample size for this study was calculated using the G*power program 3.1.0 (G power program version 3.1, Heinrich-Heine-University, Düsseldorf, Germany) for one-tailed test. The effect size for the sample size calculation was obtained from the previous studies done on mechanical neck pain [8,9,17,18,30,31]. Based on the data from these studies, it was estimated that a sample size of 30 patients in each study group would achieve a power of 80% to detect an effect size of 0.8 in the outcome measures of interest, assuming a type I error of 0.05.

Data were analysed using SPSS version 20 (SPSS Inc., Chicago, IL, USA). The Chi-square test was used to check for any statistical difference in gender distribution between the two groups. Parametric unpaired *t* test was used to compare age between the two groups at the baseline. Mann–Whitney *U* test was considered to compare baseline parameters of VAS and NDI as both are the ordinal data. Wilcoxon signed rank test was applied to compare VAS and NDI before and after the treatment in each group. Mann–Whitney *U* test along with the Bonferroni correction was used to compare post-treatment changes in VAS and NDI between the two groups. The level of significance was set at 0.025 (0.05/2).

Results

Figure 3 shows the study profile. We assessed 110 participants for inclusion and exclusion criteria. Sixty patients were randomly assigned to either the MET or stretching technique groups. Two participants from Group A dropped out due to personal reasons and two participants from Group B withdrew because they could not comply with the treatment and assessment schedule. These data were not included in the analysis. Intention to treat analysis was not used.

The baseline characteristics of both the groups are represented in Table 1. There was not much significant difference between Groups A and B at the baseline.

Table 2 shows the effect of MET and stretching technique on VAS and NDI scores at the end of Day 6. A significant difference was seen in both the groups in terms of change in pain intensity on VAS and functional disability on NDI after their respective treatment sessions ($p < 0.05$).

Table 3 shows changes in VAS and NDI between both groups and reveals that MET showed a better improvement than stretching.

Discussion

The present study was undertaken to evaluate the effect of MET and static stretching to improve pain and functional disability in patients with mechanical neck pain. Both groups showed significant improvement in VAS after receiving their respective treatments. MET reduced pain perception by increasing the stretch tolerance. Stretching

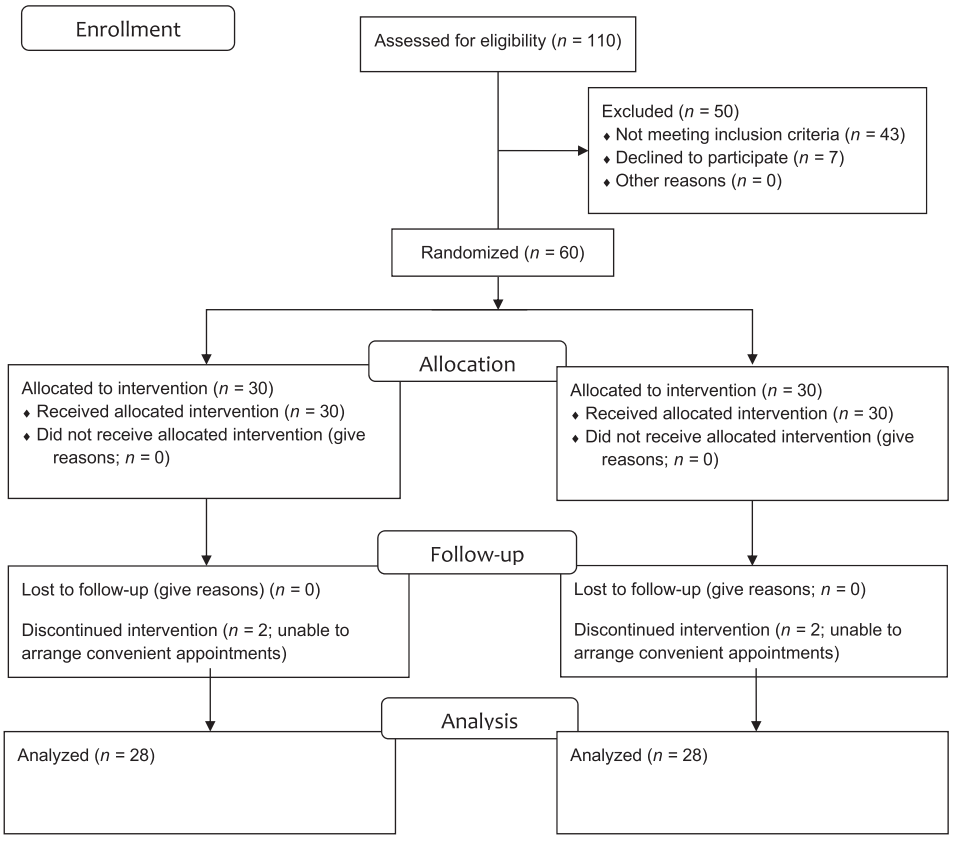

Figure 3. Flow diagram showing the progress of participants at each stage of the study.

Table 1 Baseline characteristics of the participants in both treatment groups.

	MET group $n = 28$	Stretching group $n = 28$	p
Age (y)	31.78 (1.76)	33.22 (1.71)	0.66
Sex: Female	16/28 (57)	17/28 (61)	0.78
VAS	5.5 (1.20)	5.75 (1.17)	0.43
NDI	17.25 (2.86)	17.22 (2.75)	0.92

Data are presented as mean (SD) or n/N (%).
NDI = neck disability index; SD = standard deviation; VAS = visual analogue scale.

Table 3 Between group differences of the mean difference of variables for both groups after the respective intervention.

Outcome measures	MET	Stretching	p
VAS	3.77 ± 0.93	2.06 ± 0.92	0.020*
NDI	9.25 ± 2.23	7.60 ± 1.95	0.024*

Data are presented as mean ± SD.
*$p < 0.025$ (level of significance was adjusted using Bonferroni correction) indicates significant difference between groups.
MET = muscle energy technique; NDI = neck disability index; SD = standard deviation; VAS = visual analogue scale.

and isometric contraction when occurring simultaneously stimulate the muscle and joint mechanoreceptors and proprioceptors [7]. This in turn would reduce the sensation of pain, making the consecutive stretch easier and more tolerable. The results obtained for pain reduction in the MET group could be similar to the previous studies where pain intensity reduced following MET over the neck area [30–33] and also at other areas of the body [11,34,35].

Table 2 Change in outcome measure scores in both groups after the respective interventions.

Outcome measures	MET			Stretching		
	Pre	Post	p	Pre	Post	p
VAS	5.5 ± 1.20	1.64 ± 0.78	< 0.001*	4.20 ± 1.17	2.14 ± 0.70	< 0.001*
NDI	17.25 ± 2.81	8.03 ± 2.64	< 0.001*	17.21 ± 2.70	9.6 ± 1.79	< 0.001*

Data are presented as mean ± SD.
* $p < 0.05$ indicates significant difference between groups.
MET = muscle energy technique; NDI = neck disability index; SD = standard deviation; VAS = visual analogue scale.

A study by Gupta et al [8] on effects of postisometric relaxation versus isometric exercises in nonspecific neck pain also concluded that MET showed significant improvement in pain and functional status. Our results for Group A are also supported by a study by Abha and Angusamy [36], who compared postisometric relaxation with integrated neuromuscular inhibition technique on upper trapezius trigger points and concluded that MET is effective in improving pain, and functional status. Results of a study by Sharmila [37] on effects of the MET versus conventional exercises in nonspecific neck pain in secondary school teachers are in accordance with our results for Group A, which concluded that postisometric relaxation had better reduction in pain and disability.

The reduction in the pain following static stretching could be due to the inhibitory effects of golgi tendon organs, which reduces the motor neuronal discharges, thereby causing relaxation of the musculotendinous unit by resetting its resting length and pacinian corpuscle modification. These reflexes will allow relaxation in musculotendinous unit tension and decreased pain perception [38]. Kostopoulos et al [39] found a significant pain reduction in the group treated with passive stretching of upper trapezius, which is in accordance with this study.

The results of this study for the stretching group are supported by a study conducted by Cunha et al [9] on effects of global posture re-education and static stretching on pain, range of motion (ROM) and quality of life in women with chronic neck pain which concluded that stretching showed significant improvement in outcome measures. Effects of stretching on neck pain and ROM are supported by a study, which concluded that stretching can significantly improve pain and ROM [40].

There was a statistically significant difference found in NDI in the treatment groups. This could be because the NDI assesses different aspects of neck pain which consists of pain intensity, daily activities, suggesting that improvement in the score might be due to the reduction in pain. It could also be because the MET group showed better improvements in pain which may have led to the overall improvement in the functional status of the participants thus improving the NDI score.

Group A showed a better improvement in pain and functional status than Group B. Similar results were observed by Ahmed, who concluded that the MET showed better results than stretching in improving hamstring flexibility [15]. The results of this study are also in accordance with the study by Mahajan et al [17], which concluded that MET showed significant improvement in pain and functional status in patients with mechanical neck pain. Ahmed and Abdelkarim [19] conducted a study in which they compared efficacy of MET and static stretching on hamstring flexibility post burn contractures. Treatment sessions were given for 8 days. The study concluded that MET was more effective than stretching in improving hamstring flexibility [19]. A study by Parmar et al [20] concluded that isolytic contraction was better in improving range and reducing pain.

The results of our study contradict those of Shenouda [18], who concluded that both MET and stretching are equally effective techniques. This may be because that study had included isometric neck exercises as a part of conventional exercises which was common for both groups [18]. Effects of MET could have been masked by the isometric exercises as MET itself involves isometric muscle contraction followed by stretching.

The effects of conventional treatment cannot be overlooked. This includes application of hot packs, and strengthening and stretching of specific muscles, which are prone to develop imbalance. Moist heat therapy helps to reduce pain by reducing spasm and also produce a relaxing effect. By reducing the viscosity of viscoelastic collagen, heat increases tissue extensibility and makes connective tissue less resistant to active or passive stretching [41].

A systematic review by Kay et al [42] suggested that exercise programmes consisting of stretching and strengthening exercises for the cervical or cervical and shoulder—thoracic region results in benefits in pain and function in patients with mechanical neck disorders. Therefore, in this study we included the strengthening exercises targeting muscles, which are prone to weakening, and stretching exercise was included to stretch pectoralis muscles, which mostly develop tightness.

As observed in this study, both the MET and stretching technique are effective in the treatment of mechanical neck pain. When compared, MET seem to be more effective than stretching in reducing pain and functional disability. Thus, MET can be chosen over stretching while treating the patients with mechanical neck pain. However, effects of these techniques were studied as an adjunct to the conventional therapy, which includes exercises and application of a hot pack. Thus, MET can be chosen over stretching along with the conventional exercises while treating the patients with mechanical neck pain.

This study had several limitations. The sample size was small, leading to reduced statistical power. The study did not have a control group. There may be an interaction between the treatment effects of conventional exercise programme and muscle energy technique/passive stretching. Therefore, the results could demonstrate only the relative effectiveness of the two programmes. To find out whether each programme was indeed effective in treating mechanical neck pain, further studies are required. Also long-term effects of the treatment were not studied. Groups were not matched for age and sex. Lastly, the outcome assessor was not blinded, which might have led to measurement bias.

Future studies should assess the long-term effects of the interventions. We suggest a longer duration of treatment with more sessions in order to maximize the treatment effect.

Conclusion

The present study concluded that both MET and stretching are effective in relieving pain and reducing disability in patients with mechanical neck pain. However, MET has shown a better effect than stretching in improving pain and functional status of the patients with mechanical neck pain. Thus MET can be chosen over stretching along with

the conventional exercises while treating the patients with mechanical neck pain.

Conflicts of interest

All authors have no conflicts of interest to declare.

Acknowledgements

We would like to express our heartfelt gratitude to all those who helped give our abstract thoughts a perceivable form. We would like to express our warm gratitude to Dr Rachana Dabadghav (PT) for her valuable expertise that she shared and constant encouragement, which motivated us to accomplish this research successfully. Lastly, we extend our warm gratitude to all those who participated in this study.

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