ORIGINAL ARTICLE

Effects of static stretching as compared to autogenic inhibition and reciprocal inhibition muscle energy techniques in the management of mechanical neck pain: a randomized controlled trial

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Abstract

Objective: To compare the effects of static stretching with autogenic inhibition and reciprocal inhibition muscle energy techniques on pain, disability and range of motion in patients with mechanical neck pain.

Methods: A parallel design randomised controlled trial was conducted at Fauji Foundation Hospital and Railway-General Hospital, Rawalpindi, Pakistan, from April to November, 2017, and comprised of patients aged 18-70 years with neck pain of moderate intensity scoring 4-8 on numeric pain rating scale with limited or painful range of motion. The patients were randomly allocated via lottery method into static stretching group, autogenic inhibition muscle energy technique group and reciprocal inhibition muscle energy technique group. All the subjects received five consecutive treatments sessions. Outcome measurements included numeric pain rating scale score, neck disability index score and goniometry for cervical range of motion. Data was collected at baseline and after first and fifth sessions, and was analysed using SPSS 21.

Results: Of the 78 subjects, there were 26(33.3%) in each of the three groups. Of them 7 were lost to follow-up and the study was completed by 71(91%) subjects. The overall mean age was 41.55±11.89 years ($p>0.05$). There was no significant difference between the groups at baseline ($p>0.05$). However, at first and second follow-up, there was a significant difference ($p<0.05$) between the groups in terms of immediate and short-term relief, except for immediate effects related to range of motion ($p=0.056$).

Conclusion: Significant difference existed among static stretching, autogenic inhibition and reciprocal inhibition groups in terms of pain, disability and range of motion in patients with mechanical neck pain.

Keywords: Autogenic inhibition, Cervical spine, Neck pain, Manual therapy, Muscle energy techniques, Reciprocal inhibition, Stretching. (JPMA 70: 786; 2020). **https://doi.org/10.5455/JPMA.9596**

Introduction

With a prevalence of around 75.7%, neck is the most common site of musculoskeletal discomfort among healthy young individuals,[1,2] the build-up of which can lead to neck pain which is an important public health concern worldwide.[3] The point prevalence of neck pain ranges from 5.9%[4] to 22.2%[5] for adults aged 15-74 years, with a mean prevalence of 7.6%.[3] One-year prevalence of neck pain on the other hand ranges from 16.7%[6] to 75.1%[7] for adults aged 17-70 years, with a mean prevalence of 37.2%.[3] In a few cases, degenerative joint disease (DJD) can be the direct cause of pain, but usually the exact cause of pain is muscle tension and imbalances,[8] which may secondarily lead to increased joint reaction forces, eventually leading to movement dysfunctions and joint degeneration.[9] Medication, patient education, exercise and manual therapy are commonly used in the conservative management of neck pain, but these management options are not studied in enough detail to sufficiently evaluate their effects.[10,11] In terms of preference of techniques in the management of neck pain, exercise and manual therapy are most commonly applied by physiotherapists and chiropractors.[12] Manual therapy techniques include joint mobilisation and soft tissue mobilisation techniques. Joint mobilisation focuses on restoring joint arthrokinematics whereas soft tissue

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techniques, such as muscle energy techniques (MET), focus on muscle and connective tissues. Even though literature supports the use of joint mobilisation in the management of neck pain,[13] very few studies have focussed on soft tissue and METs. Conventional static stretching (SS) is a technique commonly applied in the management of neck pain and other mechanical disorders,[14] but it focuses only on the passive component of muscle tone, which is generated by connective tissue structures such as endomysium, epimysium and perimysium,[15] whereas MET focuses not only on the passive component of muscle tone, but also on the active component generated by the sarcomeres themselves,[15] which is reduced by the use of either autogenic or reciprocal inhibition (RI) techniques. However, it is not known which of the two inhibition techniques is more effective. Moreover, conventional stretching is not indicated in acute or maximum protection phase of management,[16] whereas no such contraindication exists for MET as it relieves the muscle guarding by alleviating the active tone via reflex inhibition mechanisms.[8] In comparison to conventional stretching, literature suggests MET to be superior in improving neck pain and disability,[9,17] but the effects on range of motion (ROM) are inconclusive. Moreover, to the best of our knowledge, currently no study exists focusing on the immediate effects of autogenic inhibition (AI) and RI METs in the management of neck pain. The current study was planned to compare the effects of conventional stretching and MET in the management of mechanical neck pain in terms of pain, disability and ROM, and to determine which one of the two inhibition techniques is more effective in terms of immediate and short-term effects.

Patients and Methods

A parallel design randomised controlled trial (RCT) was conducted at the Physical Medicine and Rehabilitation Department of Fauji Foundation Hospital (FFH), Rawalpindi, and Railway General Hospital, Rawalpindi, Pakistan, from April to November, 2017.

Approval was obtained from the ethics review committee of the Foundation University, Islamabad, and Riphah International University, Islamabad, Pakistan, and the study was prospectively registered at clinicaltrials.gov (NCT03136250).

The sample size was calculated using the formula $m=2c/\delta^2+1$".[18] While keeping $\delta=0.789$ and $c=7.9$, the group size (m) was found to be 26, which meant a total sample of 78 subjects who were then randomly allocated to SS, AI-MET and RI-MET groups, via simple lottery method.

Only sub-acute and chronic (4-12 weeks) patients with neck pain of moderate intensity scoring 4-8 on the numeric pain rating scale (NPRS) with limited or painful cervical ROM and aged 18-70 years were included.[9] Patients were screened by a physiatrist before referral and patients with a positive history of trauma, fracture or surgery of the cervical spine in the preceding 12 months, signs of cervical myelopathy, radiculopathy or serious pathology, such as malignancy, inflammatory or rheumatic disorders, infection and vascular syndromes such as vertebrobasilar insufficiency (VBI), were excluded. The sample was collected using purposive sampling.

All patients were given Trans-Cutaneous Electrical Nerve Stimulation (TENS) in combination with superficial heat for 10 minutes, followed by 3 sets of unilateral postero-anterior glide (10-15 oscillations), in grade I-II for pain relief at the involved tender or painful segment regardless of the study group.[19-20] Following the pain management protocol, the SS group received three to five repetitions of conventional static stretching (15-30 seconds hold).[14] The AI-MET group received 3-5 repetitions of post-isometric relaxation (PIR) (30-50% isometric contraction of the muscle to be stretched for 7-10 seconds, followed by rest period of 5 seconds and then a stretch of 10-60 seconds hold),[8] whereas the RI-MET group received three to five repetitions of reciprocal inhibition (30-50% isometric contraction of the muscle opposite to the muscle to be stretched for 7-10 seconds, followed by rest period of 5 seconds and then a stretch of 10-60 seconds hold).[8] The techniques were applied to the muscles of the cervical spine which are prone to get short, including Ant/Middle/Posterior Scaleni, Sternocleidomastoid, Levator Scapulae and Upper Trapezius Muscles.[21-23] All participants received five consecutive treatments sessions.

The outcome measurement tools in the study were NPRS for pain, neck disability index (NDI) for disability, and cervical goniometry for ROM. The data was collected at baseline prior to the initiation of treatment, after first treatment session, and after five consecutive treatment sessions.

Data was analysed using SPSS 21. Shapiro Wilk and Kolmogorov Smirnov tests were used to determine normality of data, and data transformation was carried

Table-1: Baseline comparison of the three groups.

Variable	Mean±S.D			*p*-value
	Static Stretching (SS)	Autogenic Inhibition (AI) MET	Reciprocal Inhibition (RI) MET	
Age (in years)	43.09±8.55	40.31±13.17	41.48±13.37	0.727
Weight (in kg)	69.27±7.16	75.54±12.07	74.70±11.58	0.102
Height (in feet)	5.49±0.21	5.45±0.39	5.47±0.33	0.941
Body mass index (BMI)	24.86±3.04	27.53±4.83	26.98±4.57	0.087
Pain (NPRS)	7.59±0.73	7.69±0.47	7.65±0.49	0.828
Neck Disability Index (NDI)	50.65±9.76	44.17±12.89	43.23±14.64	0.107
Cervical Range of Motion				
Flexion	32.95±10.79	27.69±8.86	28.70±8.34	0.135
Extension	35.95±2.58	32.00±16.63	31.26±13.25	0.497
Rotation (Right)	49.55±12.62	47.15±11.87	45.52±10.62	0.516
Rotation (Left)	54.55±10.80	48.62±16.04	48.48±13.76	0.248
Lateral Flexion (Right)	26.64±6.96	25.08±5.73	25.96±5.18	0.664
Lateral Flexion (Left)	29.41±8.79	29.92±6.96	29.65±6.23	0.971

SD: Standard deviation; MET: Muscle energy techniques; NPRS: Numeric pain rating scale.

Table-2: Comparison of outcome variables after first treatment session (Immediate Effects).

Variable	Mean±S.D			*p*-value	Post hoc (*p*-value)		
	Static Stretching (SS)	Autogenic Inhibition (AI) MET	Reciprocal Inhibition (RI) MET		SS vs AI	SS vs RI	AI vs RI
Pain (NPRS)	5.64±0.79	4.77±1.79	5.65±0.65	0.020	0.046	0.999	0.038
Cervical Range of Motion							
Flexion	39.09±11.18	45.00±10.71	38.60±8.52	0.056	0.120	0.986	0.081
Extension	43.90±11.76	47.30±3.26	37.35±2.57	0.047	0.678	0.271	0.039
Rotation (Right)	58.18±12.45	74.85±8.92	58.91±6.93	<0.001	<0.001	0.965	<0.001
Rotation (Left)	59.32±9.69	75.54±8.10	60.70±11.19	<0.001	<0.001	0.882	<0.001
Lateral Flexion (Right)	29.50±5.94	36.46±4.54	31.21±3.70	<0.001	<0.001	0.455	<0.001
Lateral Flexion (Left)	31.00±7.30	41.85±3.41	34.17±4.89	<0.001	<0.001	0.121	<0.001

SD: Standard deviation; NPRS: Numeric pain rating scale.

out where required to achieve a normally distributed data. One-way analysis of variance (ANOVA) was used for comparing the groups at baseline and post-treatment. Levene's test for equality of variances was used to find out if equal variances were assumed, followed by Tuckey's test for post-hoc analysis. Confidence interval (CI) was kept at 95%, and p<0.05 was considered significant.

Results

Of the 100 subjects initially assessed, 78(8%) were included. Of them, 7(9%) were lost to follow-up and 71(91%) completed the study (Figure). The overall mean age of participants was 41.55±11.89 years, and 26(33%) participants were male and 52(67%) were female. There was no statistically significant difference among the groups in terms of mean weight, height, body mass index (BMI), NPRS, NDI or ROM at baseline (Table 1).

In terms of immediate effects after the completion of first treatment session, there was a significant difference between the groups in terms of all outcome variables (p<0.05) except for ROM in flexion (p=0.056). AI-MET group exhibited greater improvement in all outcomes compared to SS and RI-MET (p<0.05) with regards to NPRS and ROM in rotation and lateral flexion towards both sides. Also, there was greater improvement with respect to ROM in extension compared to RI-MET (p<0.05). However, there was a no significant difference between SS and RI-MET groups after the first treatment session (Table 2).

At the end of the last treatment session, a significant difference was observed for all outcome variables (p<0.05). AI-MET was overall superior to SS (p<0.05). AI-MET was also superior to RI-MET in terms of ROM (p<0.05) except extension (p=0.055), but there was no significant difference in terms of NPRS and NDI (p>0.05). RI-MET was superior to SS with respect to NDI, NPRS and ROM in rotation only (Table 3).

Table-3: Follow-up comparison of outcome variables between the groups after 5 treatment sessions (Short-term Effects).

Variable	Mean±S.D			*p*-value	Post hoc (*p*-value)		
	Static Stretching (SS)	Autogenic Inhibition (AI) MET	Reciprocal Inhibition (RI) MET		SS vs AI	SS vs RI	AI vs RI
Pain (NPRS)	4.45±1.05	1.46±1.30	2.13±0.69	<0.001	<0.001	<0.001	0.083
Neck Disability Index (NDI)	33.96±12.03	13.46±20.01	11.26±3.93	<0.001	<0.001	<0.001	0.930
Cervical Range of Motion							
Flexion	54.63±12.033	63.84±9.67	55.86±5.77	0.002	0.019	0.963	0.003
Extension	61.13±12.14	73.46±10.10	66.47±9.89	0.001	0.001	0.305	0.055
Rotation (Right)	69.41±15.10	85.54±6.35	79.13±10.80	<0.001	<0.001	<0.001	0.021
Rotation (Left)	67.64±10.89	86.08±5.87	78.96±3.38	<0.001	<0.001	<0.001	<0.001
Lateral Flexion (Right)	36.59±6.24	42.69±3.44	38.26±2.28	<0.001	0.001	0.575	<0.001
Lateral Flexion (Left)	37.50±4.82	45.77±2.20	39.00±4.23	<0.001	<0.001	0.618	<0.001

SD: Standard deviation; NPRS: Numeric pain rating scale.

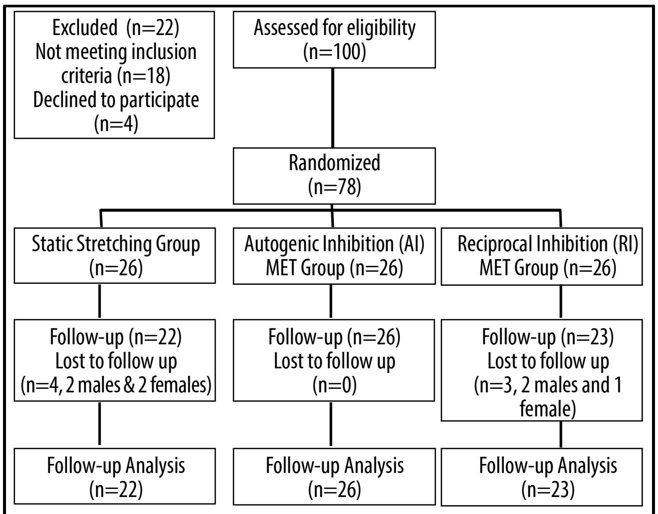

Figure: Scheme of study (CONSORT Diagram)

Discussion

In terms of immediate effects on neck pain, AI-MET was superior to SS and RI-MET, with no significant difference between SS and RI-MET. No previous study has identified the immediate effects of SS, AI-MET and RI-MET in neck pain. In terms of short-term effects on neck pain and disability, both types of MET were superior to SS with no significant difference between each other. The results of the current study are in accordance with those of Phadke et al, which also showed MET to be superior to SS for improving pain and disability in patients with neck pain. However, there was no reciprocal inhibition group in Phadke et al's study and effects on cervical ROM were not observed either.[9] On the contrary, an RCT demonstrated no significant difference between post-isometric relaxation (PIR), which is a type of AI-MET, and SS on neck pain and disability in patients with cervical spondylosis. Moreover, unlike the current study the earlier study lacked an RI-MET group.[24]

In terms of immediate effects on cervical ROM, AI-MET was superior to both SS and RI-MET in terms of ROM in rotation and lateral flexion. AI-MET was superior to RI-MET for flexion as well. However, no significant differences were observed between SS and RI-MET in terms of ROM. Based on the review of existing literature, it is important to mention that prior to this study, no evidence existed regarding the immediate effects of SS and AI-MET and RI-MET on cervical ROM.

In terms of short-term effects on ROM, AI-MET was superior to both SS and RI-MET, except for ROM in extension. However, when comparing SS to RI-MET, a statistically significant difference was observed only in terms of ROM in rotation. The findings are supported by a study showing MET to be superior over control group in terms of improving cervical ROM,[25] but due to the absence of a SS group in the study, it is not possible to conclude if MET was superior to SS in terms of improving cervical ROM.[25] On the other hand, contrary to our results, a study demonstrated no significant difference ($p>0.05$) between PIR and SS in terms of ROM in patients with cervical spondylosis.[24] In fact, the study demonstrated SS to be superior to PIR in terms of improving flexion and lateral flexion towards right ($p<0.05$).[24]

Based on contrasting findings in literature, it was not conclusive if MET is superior to SS, but the current study has demonstrated MET to be superior to SS for improving ROM. Moreover, based on the review of the existing literature, no study currently exists that may have compared the effects of AI-MET and RI-MET in improving cervical ROM. Findings of the current study can also be explained in a physiological perspective as both SS and MET improve ROM by causing muscle lengthening, but SS lengthens the muscles by focusing only on the passive tension component of the muscle,[14] whereas MET improves muscle length by reducing both active tension as well as passive tension of the targeted muscle,[8] thus suggesting MET to be superior to SS. MET inhibits the muscle via agonist (autogenic inhibition) or antagonist (reciprocal inhibition) pre-contraction, resulting in the activation of the Golgi tendon organ, thus reducing active tension, and further reducing passive tension by stretching the targeted muscle following the contraction.[8] This assumption is supported by a study showing a significant decrease in cortico-spinal and spinal reflex excitability, signifying the inhibitory role of MET over motor excitability, by demonstrating a significant increase in the silent potential duration succeeding MET unlike control, and a significant decrease in H-reflex following MET.[26]

The current study is the first to compare the effects of AI-MET and RI-MET. However, in order to better understand the neuro-physiological phenomenon of autogenic and reciprocal inhibition, studies should look into the effects of AI-MET and RI-MET in terms of electromyography (EMG), cortico-spinal and spinal reflex mechanisms.

Conclusion

AI-MET was found to superior to SS and RI-MET both in terms of immediate and short-term effects in the management of mechanical neck pain. The difference between SS and RI-MET was not conclusive.

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