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Suboccipital release versus muscle energy technique in patients with mechanical neck pain and forward head posture

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Abstract

Background: Although numerous previously published studies have dealt with various therapeutic modalities for treatment of patients with Mechanical Neck Pain (MNP) and Forward Head Posture (FHP), its management still raises many controversies.

Objectives: To examine and compare between the effects of Suboccipital Release (SOR) technique and sub occipital Muscle Energy Technique (MET) on patients with MNP and FHP.

Subjects and Methods: Thirty-six patients with MNP and FHP aged from 20-40 years were randomly assigned into three groups: Group A (study): 12 patients received SOR and traditional physical therapy, Group B (study): 12 patients received MET and traditional physical therapy, and Group C (control): 12 patients received the traditional physical therapy treatment only (hot packs and Kendel exercises). Interventions were conducted three times a week for four weeks. Craniovertebral angle (CVA) using Photographic Posture Analysis Method (surgimap software), pain intensity using Numeric pain Rating Scale (NPRS), Cervical ROM using Smartphone Clinometer application, and neck functional ability using Neck Disability Index (NDI) were assessed for all participants before and after the treatment program.

Result: There was no significant difference between groups pre-treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant improvement in NDI and NPRS in group B compared with that of group A and group C ($p < 0.05$), and a significant decrease in NDI and NPRS of group A compared with that of group C ($p < 0.01$). While there was no significant difference in ROM between groups, and no significant difference between group A and B regarding CVA post treatment ($p > 0.05$).

Conclusion: MET is more effective in reducing pain and functional disability than SOR and conventional therapy. Whereas, MET and SOR were equally effective in improving CVA and cervical ROM.

Keywords: forward head posture, Suboccipital release, muscle energy technique, mechanical neck pain

Introduction

Mechanical neck pain (MNP) is the second most prevalent condition in the world after low back pain, and up to two-thirds of persons experience this social and financial health burden [1]. Patients with MNP usually complain of intermittent pain, restriction of range of motion (ROM), muscle dysfunction, and changes in the neck posture [2].

Forward head posture (FHP) lead to a spatial change between the spine and the line of gravity, these changes in neck posture can lead to abnormal cervical movement patterns, causing weakness in the deep cervical flexors and shortening of the opposing cervical extensors [3]. It has been reported that suboccipital muscles are hypertonic in FHP, and trigger points in the suboccipital muscles are connected to FHP [4]. Suboccipital muscles have the most muscle spindles of any human muscle group, making them the "proprioceptor monitors" that play a crucial role in controlling head posture [5].

One of the suggested interventions for improving musculoskeletal disorders is suboccipital release (SOR) in which the dysfunctional joints and their muscle are moved away from their restrictive barrier into position of ease [6]. It has been reported that SOR immediately improves FHP, resulting in a significant increase in the craniovertebral angle (CVA) in asymptomatic subjects. It is also believed that SOR improved the tone of the rectus capitis posterior minor which normalize dural blood flow [7].

Muscle Energy Technique (MET) is another form of a gentle manual therapy intervention that primarily targets the soft tissues, though it also contributes significantly to joint mobilization. It has been reported that, adding MET to exercise program resulted in better improvement in CVA in FHP than exercise group only [8]. In addition, and it was stated that MET decreases hyper-activation and tightness in shortened deep cervical extensors in subjects with FHP [9].

To the best of our knowledge, no previous research has been conducted to compare the effects of SOR and suboccipital MET on the following variables: CVA, Pain intensity, Cervical ROM, and Functional ability in patients with MNP and FHP. So, this study was conducted to investigate and compare between the effects of SOR and suboccipital MET on CVA, pain intensity, cervical ROM, and functional ability in patients with MNP and FHP.

Materials and methods

Study design

This study was a Pretest posttest randomized control trial.

Subjects

This study was conducted from November 2020 to February 2022. A total of Thirty six subjects (29 females and 7 males) suffering from MNP and FHP were recruited from Outpatient Clinic of Faculty of Physical Therapy, Cairo University. The inclusion criteria were as follow: patients aged from 20-40Y [10], suffering from MNP with CVA < 53 [2], and their NDI ranging from 30-48% [11]. Patients were excluded from the study if they have injury or trauma to cervical region, spinal surgery, cervical canal stenosis, radicular pain and malignancy. No patient from any group dropped out during treatment, as shown in Figure 1.

Randomization

Randomization took place as follows; Thirty-six folded papers marked (A), (B) or (C) were put in a box; then each subject was asked to pick a paper out of that box. The subjects were then assigned to their group according to the letters chosen. Group (A) (study group) twelve patients received SOR and traditional physical therapy treatment. Group (B) (study group) twelve subjects received MET for suboccipital muscles and traditional physical therapy treatment, and Group (c) (control group) twelve patients received traditional physical therapy treatment (hot packs and Kendel exercises) [12, 13].

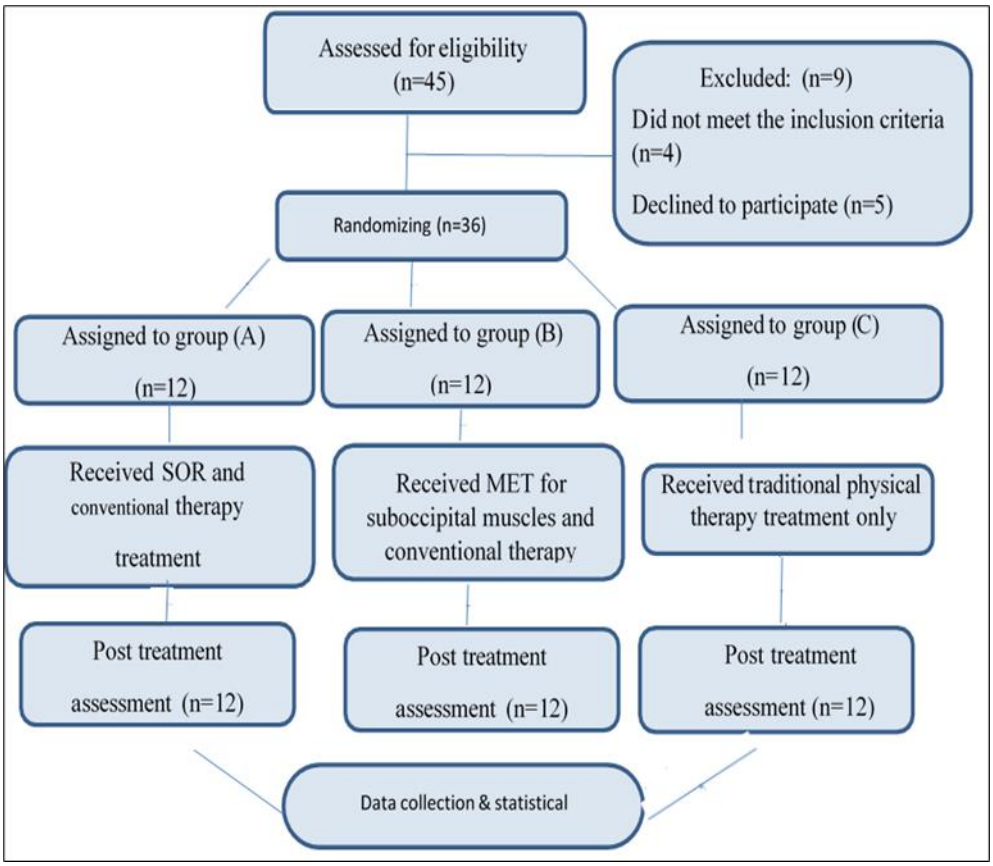

Fig 1: Flow chart of patients' randomization

Instrumentation and procedures

Instrumentation and procedures for Assessment

All subjects were assessed before the first session and after the end of the treatment program. The assessment procedures include the following items:

a. Assessment of CVA using photographic posture analysis method

surgimap software (http://www.surgimape. com) was used to determine the CVA which is proved to be valid and reliable for measuring CVA [14], 64-mega pixel camera (Sum sung A71) was positioned on a tripod stand to capture side view photos of subjects [15]. The distance between the camera and the participant was 50 cm. The base of the camera was leveled to the participants' shoulder level.

After the camera was positioned, the patients were asked to stand in a relaxed position and look forward at a point at the eye level. Right ear tragus and C7 spinous process were marked and a side view was captured.

b. Assessment of cervical ROM with clinometer Smartphone application

Phone application (Clinometer) was used to measure cervical spine ROM using android OS, smart phone (sumsung A71) [16]. This application, consists of a digital compass-clinometer module, a data visualization module, a data analysis module, and a data management module. The compass-clinometer module measures the orientation of geological structures using data collected from built-in sensors. It is a reliable and valid device for assessing cervical flexion, extension, lateral flexion, and now, rotation [17].

Cervical active ROM in flexion and extension, right/left side bending, and right/left rotation was measured for each patient. Prior to measurement, the subject removed eyeglasses, hats, and jewelry; wore a T-shirt; lifted and fastened any hair that was covering the ears, neck, or eyes; sat in a chair; and observed a brief demonstration of the 6 cervical motions to be performed.

- **Cervical flexion and extension**
  From sitting position with securing the smartphone on the lateral (right) side of head, and head and neck in the anatomically neutral position was first performed, instructions given to the subject for performance of flexion were, tuck your chin first, then move your head forward and down as far as possible; while the instructions for extension were, raise your chin first, then move your head backward, looking up as far as possible. To avoid thoracic movement, the subject was also instructed, do not move your shoulders or change the amount of pressure being applied to the backrest of your chair.

- **Cervical right and left lateral bending**
  From sitting position and head and neck in the anatomically neutral position, with securing the smartphone on the anterior surface of head over the forehead; specific instructions for performance of side bending in each direction were given to the patient straight ahead and side-bend your neck by moving your ear toward your shoulder as far as possible. To avoid thoracic and shoulder girdle movement, the subject was also instructed, do not move your shoulders, and the therapist stabilized the contralateral shoulder.

- **Cervical right and left rotation**
  The subject was lying in a supine position on a plinth securing the smartphone over the top of the head, and head and neck in the anatomically neutral position was first performed. Specific instructions for performance of rotation in each direction were, turn your head, as far as possible. To avoid thoracic and shoulder girdle movement, the subject was also instructed, do not move your shoulders or change the amount of pressure being applied to the plinth, and the therapist stabilized the contralateral shoulder.

c. Assessment of pain intensity using Numerical pain Rating Scale

Pain intensity was measured by Numeric Rating Scale (NRS). NRPS exhibits fair to moderate test-retest reliability in patients with MNP [18]. The patient was asked to mark the number that represent his intensity of pain, in which 0 represents (no pain) and 10 represents (the worst pain imaginable).

d. Assessment of neck functional ability using Neck Disability Index

The Arabic version of the NDI was proved to be a reliable, valid and responsive tool that can be used to assess neck pain in Arabic speaking patients with neck pain [19]. Neck disability index scores vary from 0 to 50, where 0 is considered "no activity limitation" and 50 is considered "complete disability". Questions include activities of daily living, such as: personal care, lifting, reading, work, driving, sleeping, recreational activities, pain intensity, concentration and headache. The questions are measured on a six-point scale from 0 (no disability) to 5 (full disability). The index was calculated by dividing the summed score by the total possible score, which was then multiplied by 100 and expressed as a percentage.

Intervention

Traditional physical therapy program

Patients in all groups received the same traditional physical therapy program, three times a week for four weeks. This includes hot packs followed by Kendall exercises. The patients received firstly, hot pack for 20 minute. Electrical hot pad was connected to the current and switched on and protection against overheating is considered by taking feedback from the patient [12].Then, Kendall exercises were performed as follows: (a) Strengthening the deep cervical flexors: The patient was asked to lay flat on the back with the chin down hold this position for 2–8 seconds, (b) Stretching the cervical extensors: The patient was asked to place one hand on the occipital area and other on chin in a sitting position followed by a flexed neck posture with the head down to stretch the cervical extensors, (c) Strengthening shoulder retraction: This exercise was done using a Thera Band around a secure object and then, the patient was asked to pull the band back with both hands as far as possible to move the shoulder blades toward each other in a standing position, (d) Stretching of the pectoralis major muscle: The therapist stood behind the patient and held both elbows and performed bilateral pectoralis stretching. Every strengthening exercise was repeated for 12 repetitions and done for 3 sets and each stretching exercise was hold for 30 seconds and repeated 3 times [13].

Group A (Study group)

A total of 12 patients received SOR plus the same traditional physical therapy program, three times a week for four weeks. The patient was asked to lie in a relaxed supine position on the bed and the therapist sitting on chair at the level of patient head, then the therapist put his finger pads of four fingers on both sides of C2 under the occipit area and holding the pressure till feeling melting sensation, the intervention time was 4 min. During the SOR procedure, the patient was asked to close both eyes to prevent eye movements that could influence suboccipital muscle tone [2].

Group B: (Study group)

A total of 12 patients received suboccipital MET plus the same traditional physical therapy program, three times a week for four weeks. The patient was asked to take supine relaxed position and the therapist was standing at his head level and put one hand on his occipit (carrying his head) and his other hand was on the patients, forehead and gave him sub maximal resistance for cervical extension hold for 10sec, and then patient was asked to relax and therapist performed suboccipital stretch and hold it for 20sec, this was repeated 3 times (which induces post isometric relaxation in the previously contracted tissues) [20].

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and had been approved by the Ethics Committee of the Faculty of Physical Therapy, Cairo University (NO: P.T.REC/012/003037).

Informed consent

Informed consent had been obtained from all individuals included in this study.

Sample size determination

Sample size was determined a priori using G*POWER statistical programming (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany). To test size estimation [F tests-ANOVA: Repeated measures, within-between interaction, α=0.05, β=0.10, number of predictors=2, number of dependent=1, Partial Eta Squared = 0.098, and effect size=0.322] and revealed that, the appropriate sample size for this study was N=36]. This effect size calculated from pilot study on 15 participants (5 in each group) with CVA was the primary outcome.

Statistical analysis

Descriptive statistics and unpaired t-tests were used to compare the subject characteristics between groups. Chi-squared test was used to compare the sex distribution between groups. Shapiroe Wilk test was used to verify the normal distribution of the data. Levine's test for homogeneity of variances was performed to ensure homogeneity between groups. Mixed MANOVA was conducted to compare the effect of time (pre versus post) and the effect of treatment (between groups), as well as the interaction between time and treatment on mean values of CVA, NDI, NRPS and ROM. The level of significance for all statistical tests was set at $p< 0.05$. Statistical analysis was performed through the statistical package for social studies (SPSS) version 25 for windows.

Results

Subject characteristics

Table (1) showed the subject characteristics of all groups. There was no significant difference between groups in age, weight, height, BMI and sex distribution ($p > 0.05$).

Table 1: Basic characteristics of participants

	Group A	Group B	Group C	p-value
	$\overline{X}$ ±SD	$\overline{X}$ ±SD	$\overline{X}$ ±SD	
Age (years)	27.83 ± 5.89	27.91 ± 7.7	26.66 ± 6.31	0.87
Weight (kg)	66.16 ± 5.04	67.58 ± 7.25	68.58 ± 5.01	0.6
Height (cm)	164.25 ± 6.63	167 ± 6.67	165.5 ± 7.41	0.62
BMI (kg/m²)	24.63 ± 2.73	24.21 ± 2.09	25.16 ± 2.89	0.67
Sex distribution				
Females	9 (75%)	8 (67%)	10 (83%)	0.64
Males	3 (25%)	4 (33%)	2 (17%)	

SD, standard deviation; p-value, level of significance

Effect of treatment on CVA, NDI, NPRS and neck ROM

Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F = 4.06$, $p = 0.001$). There was a significant main effect of time ($F = 128.01$, $p = 0.001$). There was no significant main effect of treatment ($F = 1.41$, $p = 0.17$). Table 2-3 showed descriptive statistics of CVA, NDI, NRPS and ROM and the significant level of comparison between groups as well as significant level of comparison between pre and post treatment in each group.

Within group comparison

Within-group comparison revealed increase in CVA in group A and B ($p< 0.001$) and no significant difference in group C post treatment compared with that pre-treatment ($p=0.21$), while there was a significant decrease in NRPS and NDI in the three groups post treatment compared with that of pre-treatment ($p< 0.001$) as shown in (table 2). There was a significant increase in ROM in the three groups post treatment compared with that pre-treatment ($p < 0.001$) as shown in (table 3).

Between group comparison

Comparison between groups post treatment revealed no significant difference between group A and B regarding CVA post treatment ($p > 0.05$), while there was a significant difference between group A and C ($p=0.03$), and between group B and C ($p=0.001$). There was a significant improvement in NDI and NPRS in group B compared with that of group A and group C ($p < 0.05$), and a significant decrease in NDI and NPRS of group A compared with that of group C ($p < 0.01$) as shown in (table 2). While, there was no significant difference in ROM between groups as shown in (table 3).

Table 2: Mean CVA, NDI and NRPS pre and post treatment of group A, B and C

	Group A	Group B	Group C		p-value	
	mean ± SD	mean ± SD	mean ± SD	A vs B	A vs C	B vs C
CVA (degrees)						
Pre treatment	46.53 ± 3.37	47.15 ± 3.94	47.84 ± 2.98	0.9	0.62	0.87
Post treatment	51.29 ± 2.19	53.26 ± 2.49	48.55 ± 2.92	0.15	0.03	0.001
	p = 0.001	*p* = 0.001	*p* = 0.21			
NDI (%)						
Pre treatment	39.33 ± 4.43	37.17 ± 5.42	36 ± 6.82	0.61	0.33	0.86
Post treatment	17.5± 2.23	13 ± 4.39	21.17 ± 3.29	0.008	0.03	0.001
NRPS	*p = 0.001*	*p = 0.001*	*p = 0.001*			
Pre treatment	7.25 ± 0.75	7.08 ± 0.99	7.33 ± 0.88	0.89	0.97	0.77
Post treatment	3.16 ± 0.83	2.33 ± 0.49	4.16 ± 0.83	0.02	0.006	0.001
	p = 0.001	*p = 0.001*	*p = 0.001*			

SD, Standard deviation; p-value, Level of significance

Table 3: Mean ROM pre and post treatment of group A, B and C

ROM (degrees)	Group A	Group B	Group C		p-value	
	mean ± SD	mean ± SD	mean ± SD	A vs B	A vs C	B vs C
Flexion						
Pre treatment	55.33 ± 6.63	57.91 ± 9.55	56 ± 10.12	0.75	0.98	0.85
Post treatment	68.16± 11.06	73.08 ± 8.4	66.5 ± 8.81	0.42	0.9	0.22
	p = 0.001	*p = 0.001*	*p = 0.001*			
Extension						
Pre treatment	56.83 ± 9	57.83 ± 7.98	54.25 ± 12.55	0.96	0.81	0.66
Post treatment	71± 10.92	66.5 ± 11.92	67.58 ± 10.73	0.59	0.73	0.97
	p = 0.001	*p = 0.003*	*p = 0.001*			
Right bending						
Pre treatment	44.83 ± 9.67	46.91 ± 8.63	43.58 ± 7.07	0.82	0.93	0.61
Post treatment	54.33± 7.67	57 ± 8.9	57.66 ± 7.61	0.97	0.57	0.7
	p = 0.002	*p = 0.001*	*p = 0.001*			
Left bending						
Pre treatment	40.33 ± 7.82	41.83 ± 8.92	41.58 ± 6.96	0.88	0.92	0.99
Post treatment	54± 11.69	56.83 ± 10.65	55.25 ± 10.55	0.8	0.95	0.93
	p = 0.001	*p = 0.001*	*p = 0.001*			
Right rotation						
Pre treatment	66.16 ±8.98	63.83 ±8.71	63.75 ± 10.29	0.81	0.8	1
Post treatment	77.5± 5.96	79.25 ±5.39	74.33 ±7.72	0.78	0.45	0.16
	p = 0.001	*p = 0.001*	*p = 0.001*			
Left rotation						
Pre treatment	69.41 ±9.88	67.41 ±9.9	66± 7.73	0.85	0.64	0.92
Post treatment	81.58 ±6.93	80.42 ±5.74	78.08 ±7.2	0.9	0.41	0.67
	p = 0.001	*p = 0.001*	*p = 0.001*			

SD, Standard deviation; p-value, Level of significance

Discussion

This study was conducted to examine and compare between the effect of SOR technique and suboccipital MET on patients with MNP and FHP. This study demonstrates that, the group received MET technique showed more improvement in NDI and NPRS than that of SOR group and control group, and a significant decrease in NRPS and NDI of SOR group compared with that of the control group. While there was no significant difference in ROM between groups, and no significant difference between the effect of SOR technique and MET technique on CVA post treatment.

Regarding the results of SOR group, there was a significant difference between pre and post treatment regarding all variables. These findings are consistent with reports from other authors including Heredia *et al*., [7] who concluded that Suboccipital muscle inhibition technique immediately improved the position of the head with the subject seated and standing positions. The possible explanation of these findings may be that SOR technique improved the tone of the rectus capitis posterior minor which normalize dural blood flow. It was also suggested that soft tissue mobilization, such as that achieved during the SOR technique, decreases hyperactivation and tightness in shortened deep cervical extensors in subjects with FHP [4].

Regarding the results of MET group, there was significant difference between pre and post treatment regarding all variable. These findings is consistent with reports from Phadke *et al*., [9] who stated that MET was better than stretching technique in improving pain and functional disability in people with MNP.

Also, Joshi *et al*., [21] concluded that the combined effect of MET and posture correction exercises provides better results than exercises only for neck ROM and MET should be included in the treatment of individuals with FHP. The mechanism behind this result may be neurophysiologic mechanism that it activated Golgi Tendon Reflex, inhibits the alpha motor neuron and thereby inhibited Suboccipital muscles [8].

Secondly, traction provided by the therapist stretched the fascia of the posterior neck and the suboccipital muscles and there by increased extensibility and viscoelasticity of the muscles. By applying MET to suboccipital muscle induced the down-stream effect from neck to shoulders as these muscles are important part of the myofascial superficial back lines. So, it was suggested that the effects include improved local oxygenation, enhanced venous and lymphatic circulation, as well as having a positive influence on both static and kinetic posture, because of the effects on proprioceptive and interoceptive afferent pathways [8] In contrast to the findings of the current study, Gillani *et al*., [22] proved that MET and static stretching were found to be equally effective in decreasing pain, improving cervical ROM and reducing neck disability in patients with cervical dysfunction. This may be due to different age group and different time interval between the two studies.

Concerning to results in the control group, there was significant difference between pre and post treatment regarding pain, neck functional ability and cervical ROM, while there was no significant difference in CVA. This finding is in contrast with Suvarnnato *et al*., [11] who concluded that exercise program only can improve CVA, pain, NDI and ROM in patients with FHP. This may be explained by the significant effect of exercise program guided by strengthening and stretching principles on the underlying soft tissue imbalances including deep cervical flexor and shoulder retractor strengthening as well as cervical extensor and pectoral muscle stretching [23].

It was reported that the degree of FHP according to the CVA can be used as a significant index in determining the resulting functional disability of the neck. Furthermore, it has been reported that CVA is associated with the manifestation of neck pain, and the severity of the pain is associated with the

degree of functional disability [2]. Regarding the results of CVA, it was equally increased in MET group and SOR group, and this finding is in agreement with Maitrayee *et al*., [24] who stated that SOR technique and Suboccipital MET were both equally effective in improving CVA angle in upper cross syndrome medical students. Also, the result was supported by Contractor *et al*., [8] who concluded that; adding MET to exercise program resulted in better improvement in CVA in FHP than exercise group only. In addition, Heredia *et al*., [7] proved that SOR with exercises improve the CVA better than exercises only.

Pain and neck functional disability were improved better in MET group than SOR group and conventional therapy. This is convenient with the study of Khan *et al*., [25] who concluded that patients with MNP can benefit from the post isometric relaxation with significant improvement in pain, disability rather than myofascial release. Also, Sakshi *et al*., [26] stated that, there was more reduction in pain, disability in subjects treated with MET and exercises than exercises alone in patients with MNP. Furthermore, Aggarwal *et al*., [27] observed that SOR technique along with conventional treatment significantly improve neck pain, disability, and ROM in FHP. On the contrary, Waje and Satralkar [24] concluded that SOR technique was more effective than Suboccipital MET in reducing chronic neck pain, this is might be due to difference between age groups and treatment duration between the two studies.

Limitations

The main limitation of this study could be that the treating physiotherapist was not blinded to the group allocation. Furthermore, the study considered only the immediate effects of SOR and MET on the outcome measures and did not reflect the long-term effects.

Conclusion

Suboccipital MET is more effective in improving pain and neck functional ability than SOR and conventional therapy. Whereas, MET and SOR were equally effective in improving CVA and cervical ROM.

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Conflict of interest

The authors declare that they have no conflict of interest

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