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EFFECTS OF PHONOPHORESIS WITH AND WITHOUT MUSCLE ENERGY TECHNIQUE ON PAIN, CERVICAL RANGE OF MOTION & FUNCTIONAL DISABILITY IN PATIENTS WITH DEGENERATIVE CERVICAL RADICULOPATHY; A RANDOMIZED CONTROLLED TRIAL

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HIGHLIGHTS

- This randomized controlled trial was conducted in the physical therapy OPD of Allied hospital, Faisalabad. Fifty individuals with degenerative cervical radiculopathy were recruited for the study.
- Group A received ketoprofen phonophoresis along with muscle energy technique. Meanwhile, group B received ketoprofen Ph P. Both groups also received conventional therapy and participants in them received their respective therapy in 12 sessions and four weeks.
- Phonophoresis is found to be good for cervical radiculopathy treatment, but its coupling with muscle energy technique is more beneficial in improving the range of motion and reducing pain and functional disability.

ABSTRACT

BACKGROUND: The muscle energy technique and phonophoresis interventions are incredibly affordable, non-invasive and efficient in treating pain and muscle spasms, enhancing the range of motion and reducing functional impairment in degenerative cervical cancer radiculopathy.

OBJECTIVE: To determine the effects of phonophoresis with and without muscle energy technique on pain, cervical range of motion and functional disability in patients with degenerative cervical radiculopathy.

MATERIAL & METHODS: This randomized controlled trial was conducted in the physical therapy OPD of Allied hospital, Faisalabad. Fifty individuals with degenerative cervical radiculopathy were recruited for the study. They were randomized into two groups where group A received ketoprofen phonophoresis along with muscle energy technique. Meanwhile, group B received ketoprofen phonophoresis. Both groups also received conventional therapy. Participants in both groups received their respective therapy in 12 sessions and four weeks. Primary outcome measures were pain intensity and active range of motion. The secondary variable was functional disability. These were monitored three times: before treatment, in 2nd week, and 4th week.

RESULTS: Mean age was almost 44 years in group A and 42 years in group B. Both groups showed improvement in all statistically significant variables within the group. In between groups analysis, group A showed significant results statically in reducing pain, ROMs, and functional disability, i.e. ($p<0.05$). Group A showed more improvement except for contralateral lateral flexion and contralateral rotation, but it was not statistically significant ($p>0.05$).

CONCLUSION: Phonophoresis is found to be good for cervical radiculopathy treatment, but its coupling with MET is more beneficial in improving ROMs and reducing pain and functional disability.

KEYWORDS: Degenerative cervical radiculopathy, ketoprofen phonophoresis, autogenic inhibition MET, post-isometric relax, multimodal approach.

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INTRODUCTION

Cervical radiculopathy is a condition associated with the dysfunction of nerve roots of the cervical region, which in most cases is caused by the compression exerted mechanically on nerve roots. It is a reasonably common disorder.[1] Material ejected due to disc herniation, or the formation of bony spurs may lead to nerve impingement, producing the symptoms of cervical radiculopathy. However, a large percentage of instances of cervical radiculopathy are caused by cervical spondylosis rather than soft disc herniation. The common symptoms of this impingement are a pain in the neck, radiating pain in the arm, and sensory or motor impairments in the upper limbs and cervical region.[2,3] In the acute stage or for at least an early six weeks stretch the time of cervical radiculopathy. It is advisable that the condition should be managed with non-operative conservative treatment approaches, especially if there is no myelopathy. These approaches may include limiting or diminishing mobility or activity, medication, physical therapy, and epidural steroid injections.[1]

Delivering a topically administered medicine through the skin with ultrasound is known as phonophoresis (PhP) and is thought to fasten functional recovery by reducing pain and fostering healing.[3] It avoids injection site complications and the first-pass metabolism process in the digestive system.[4] Ketoprofen, as previously mentioned, is usually recommended as an "NSAID." It prevents the body from synthesizing specific molecules that cause aches and discomfort. Ketoprofen gel will have a localized impact rather than an overall effect when applied topically on the skin. The skin absorbs it before penetrating more deeply into inflammatory body parts.[5] MET application by either of the two techniques, i.e., reciprocal inhibition (RI) or autogenic inhibition (AI), can be effective, but which of these inhibitory strategies is more efficient is unknown. The evidence shows that MET excels in traditional stretching in reducing neck discomfort and impairment, but the range of motion (ROM) results are not definitive.[6,7] A multimodal way of treating cervical radiculopathy has also involved the use of manipulation manual therapy or mobilization manual therapy.[8] The muscle energy technique and the phonophoresis intervention are two incredibly affordable, non-invasive methods that have shown to be very efficient in treating pain and also muscle spasms, hence enhancing ROM and reducing functional impairment.

Since incorporating MET with phonophoresis in the treatment regimen may generate advantages and benefits in their everyday activities, functionality, and working life, their effects were considered to be evaluated in this study to establish their combined results in the treatment of degenerative cervical radiculopathy. This current study aimed to inspect the impact of phonophoresis alone and when it is coupled with MET on pain, and active restricted range of motion in the neck, thus leading to functional disability in symptomatic cervical radiculopathy complaints.

MATERIAL AND METHODS

This randomized controlled trial was conducted in Physical Therapy OPD of Allied hospital. The approval was accorded by the University of Lahore institution's ethics committee (IRB-UOL-FAHS/907/2021). This trial has been registered in the Iranian registry of clinical trials under IRCT Id: IRCT2021113005323N1. A convenient sampling technique was used to recruit 50 patients with degenerative cervical radiculopathy who fulfilled the selection criteria.

To be included in the study, the patients were

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screened for; ages between 30-65 years, both genders, patients diagnosed with the subacute phase of CR based on the patient's history, physical exam results, or who were referred/recommended by a doctor, Patients diagnosis of CR based on prediction rule were included, i.e. (a) Noted unilateral upper limb impairments in sensory and motor function (such as weakness in muscles, paresthesia and sharp kind of pain), (b) positive results of at least three of the four following mentioned tests (Spurling's test, The ipsilateral spinal rotation of neck < 60 degrees, Distraction test, Neurodynamic Test 1 of Upper Limb).[9-11] The reasons why the patients were disqualified from the study were: Patients with Type 1 diabetes, Diseases of the PNS, Diseases of the CNS, Polyneuropathy, Malignancy, Previous history of neck-related surgical interventions, Indication of specific surgical (For instance, progressive neurological deficit),[12] Red flags, Steroid administration via injections into the cervical spine within the last two weeks, Currently using steroidal medicine for complaints of radiculopathy.[11]

Pain severity and intensity were measured with the visual analog scale (VAS), which gauges pain on a spectrum ranging from 0 to 10. A response of 0 to 3 denotes the minor or mild intensity of pain, whereas 3 to 7 and 7 to 10 imply moderate/medium and extreme/severe pain, accordingly. Respondents were asked to state their severity of pain by checking the respective option.[3,5] A universal goniometer of Plastic which had a full body circle with long arms was employed to monitor the available cervical ranges. The approximate active ranges are; 45° to 50° of flexion, 85° of extension, 40° of lateral flexion, and 90° of axial rotation.[13]

The neck disability index (NDI) was employed to quantify functional disability. The NDI is made of 10 sections. Seven sections are related to activities of daily living, 2 related to pain, and 1 related to concentration. Higher scores indicate more impairment; each 5-point Likert scale from 0 to 5, and the overall score is concluded as a percentage[3] All patients recruited in the study were given a quick understanding of the study before even being asked to confirm by signing the informed consent form. Implementing the process of lottery-based randomization, every other selected research participant was randomly sorted into two study arms. Muscle energy technique (MET) plus ketoprofen gel phonophoresis (ketoPhp) were offered to Group A (n = 25). Meanwhile, Ketoprofen phonophoresis was offered to Group B (n = 25). For a series of 12 appointments over four weeks, participants in both groups had their respective therapy three times alternative days per week.

All patients (both groups) got a treatment of conservative physical therapy programs covering manual cervical traction for 10 minutes, with 10 seconds of pulling and 5 seconds of relaxing. Thermotherapy (moist heating pack) was given before the scheduled treatment for 15 minutes, and active ranges of motions were performed in 3 sets with ten repetitions.

Ketoprofen phonophoresis was offered to all patients in either group and the ultrasound equipment adjustments were customized to a frequency of 1 megahertz and 1.5 W/cm^2 and were applied three times to the region of the cervical each week for 10 minutes/session. Continuous mode specification of ultrasound was employed in a circular pattern. [5,14-16] Ketoprofen-formulated gel (Fastum) was mixed proportionally with non-medicated acoustic gel, and then this blend was used as coupling. The autogenic inhibition MET (AI-MET) was adopted to address patients' condition of CR in Group A (ketoPhp + MET).

The neck of the patient was drawn to the extent of pathological hindrance point in ROM at which the movement (that was currently being worked on at the moment) was resisted while the patient was in lying flat on the plinth in supine. The researcher then introduced resistance in the reverse

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direction, causing the isometric contraction to operate (active contraction) heading in a certain direction, away from the site of a pathological restriction. This contraction costs 20% submaximal exertion (According to the convention, the patient should only elicit max. power that both practitioner and patient can tolerate easily). The sustaining timespan of contraction was 8 seconds while a steady breathing cycle was preserved. The patient was instructed then to let go of the contraction by relaxing the corresponding muscle. The newly attained pathological barrier in ROM was reached by gradual passive movement, and the provision of a gentle stretch for 20 seconds was offered by the researcher. Succeeded by 5 seconds of rest before the next round.

For this next barrier point, the identical steps were executed once again. Each round/cycle was done four times during one appointment.17-19 In this study, both the statistician (data analyst) and the outcomes investigator/assessor (fellow physiotherapist) were blinded. The patient's grouping and course of therapy were not informed to them. The same investigator/assessor collected the measurements and scores variables from the patients from either group at all three stages of investigations. NSAIDs or analgesics were prohibited for patients to consume throughout the follow-up term.

Version 25 of SPSS software was used first to handle data input and later for analyzing it. Quantitative variables were described with their mean values along with their standard deviation values. Meanwhile, qualitative variables were illustrated with their frequencies and their percentages. The normality of the data was assessed through the Kolmogorov-Smirnoff test. Moreover, Friedman's test calculated within-group variations in outcome measures, and Mann Whitney U-test tested the variation in outcome measures between groups. The level of significance was defined as a P-value of less than 0.05.

RESULTS

Fifty patients became part of the trial. Five patients (3 from group A and 2 from group B) didn't adhere to the full length of the study follow-up timespan. One dropout's cause was not evident. About 12% in group A and 8% in group B was the loss to follow-up proportion. The loss of follow-up data was handled with the intention-to-treat method. The Kolmogorov-Smirnova and Shapiro-Wilk test application demonstrated that the p-value was significant ($p<0.05$). Thus the data was not normally distributed, and therefore, it is non-parametric.

Both groups showed improvements in all dependent variables, and the improvements were statistically significant within the group analyzed by Friedman's test. Pain intensity in both groups ($p<0.05$), forward flexion ROM in both groups ($p<0.05$), extension ROM in both groups ($p<0.05$), ipsilateral lateral flexion ROM in both groups ($p<0.05$), contralateral lateral flexion ROM in both groups ($p<0.05$), ipsilateral rotation ROM in both groups ($p<0.05$), contralateral rotation ROM in both groups ($p<0.05$).

But when the Man Whitney test analysis was run between groups, group A (ketophp + MET) showed better results in reducing pain ($p<0.05$), increasing forward flexion, extension, ipsilateral lateral flexion, and rotation ranges of motion ($p<0.05$) and functional disability ($p<0.05$). For contralateral lateral flexion, group A showed more improvement than group B, but it was not statistically significant ($p>0.05$). At baseline, the mean value for group A (18.76) was less than group B's (26.20). Both groups showed almost equal effect up to the 2nd week, but in the 4th week, group A was seen to be more successful (group A mean= 33.32 & group B mean=32.40). Similarly, for contralateral rotation, group A showed more improvement than group B, but it was not statistically significant ($p>0.05$). At baseline, the mean value for group A (42.16) was less than group B's (44.40). Group A was seen to be more successful in increasing the range after 2 week's

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treatment, and also, after 4 weeks, group A was more successful (group A mean= 57.72 & group B mean=54.16). The effectiveness of METs has been examined in many types of research.

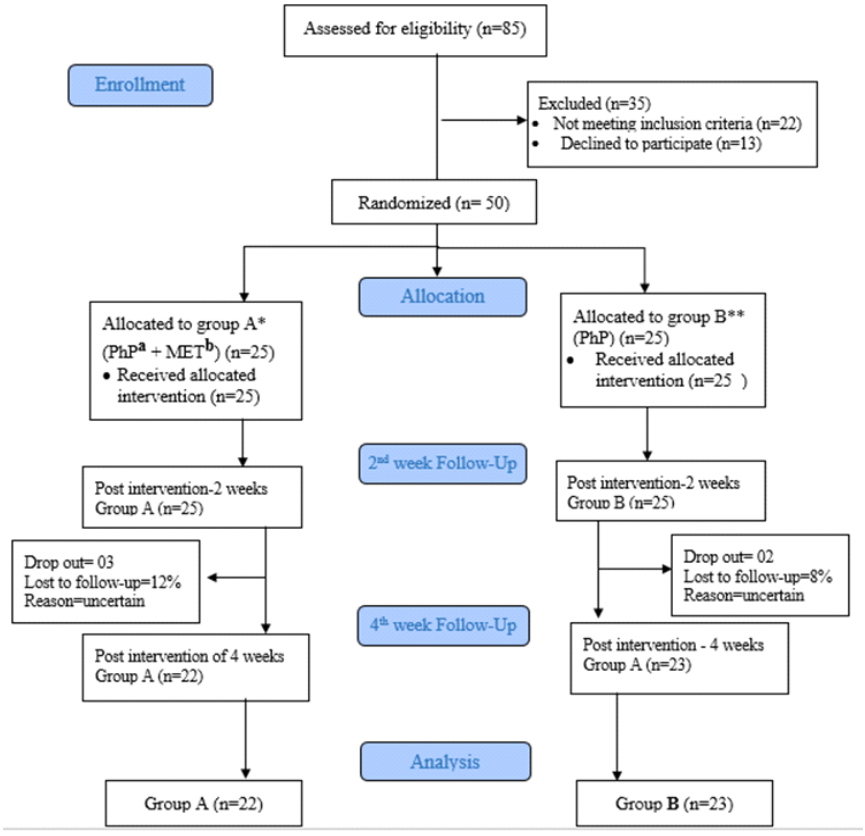

Figure 1. Consort Flow Chart

[a] Phonophoresis intervention
[b] Muscle Energy technique
* Group A (ketoprofen phonophoresis and Muscle Energy Technique)
** Group B (ketoprofen phonophoresis)

Table I: Age of Participants

	Group-A (ketoPhP+MET)	Group-B (ketoPhP)
n	25 (11 male;14 female)	25 (14 male;11 female)
Mean	44.08	42.20
SD	8.067	5.538
Minimum	32	35
Maximum	60	55

Table II: Gender (Frequency)

Treatment Group		Frequency	Percent
Group A (KetoPhP +MET)	Male	11	44.0 %
	Female	14	56.0 %
	Total	25	100.0 %
Group B (KetoPhP)	Male	14	56.0 %
	Female	11	44.0 %
	Total	25	100.0 %

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Table III: Results for the Group A and Group B Subjective Outcome Parameters

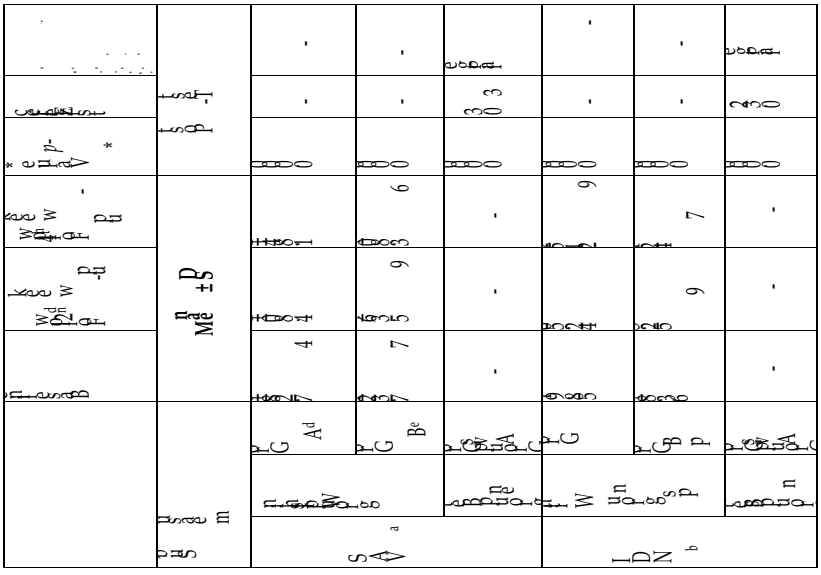

Table IV: Results for the Group A and Group B Objective Outcome Parameters

			Baseline	2nd week Follow-up	4th week Follow-up	*p*-Value**	Effect size	Cohen's Effect* of size descriptor
Objective outcome measures CAROM[a]			mean±SD			Posttest		
Forward flexion (0-50°)	Within groups	Group A[b]	24.20±5.148	31.88±6.815	38.48±7.389	0.000	–	–
		Group B[c]	23.92±4.536	28.08±5.515	34.76±7.384	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.032	0.092364	small
Extension (0-85°)	Within groups	Group A	21.24±4.728	25.68±4.598	35.00±6.384	0.000	–	–
		Group B	21.60±4.330	25.52±4.656	31.28±5.976	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.036	0.087446	small
Ipsilateral lateral flexion (0-40°)	Within groups	Group A	23.32±12.482	28.76±10.047	36.80±5.292	0.000	–	–
		Group B	18.60±10.805	25.32±9.227	29.96±8.691	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.006	0.15169	small
Contralateral lateral flexion (0-40°)	Within groups	Group A	18.76±9.606	26.16±7.093	33.32±5.391	0.000	–	–
		Group B	26.20±9.215	29.16±7.925	32.40±6.874	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.876	0.000487	small
Ipsilateral rotation (0-90°)	Within groups	Group A	43.68±22.757	51.96±21.538	57.60±19.238	0.000	–	–
		Group B	34.12±16.863	40.16±16.275	43.80±14.474	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.009	0.135408	small
Contralateral rotation (0-90°)	Within groups	Group A	42.16±21.692	50.84±19.241	57.72±17.411	0.000	–	–
		Group B	44.40±22.873	49.72±21.690	54.16±20.840	0.000	–	–
	Between groups	Group A vs Group B	–	–	–	0.277	0.023545	small

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DISCUSSION

It was speculated that a combination of MET and ketoprofen phonophoresis would have superior effects on pain, ROMs, and disability index of the neck in cervical radiculopathy patients and PhP would have the same effect as PhP + MET on pain, ROMs and disability index of the neck in cervical radiculopathy patients. The study's findings partly confirmed our prior alternative hypothesis, as when the analysis was run between groups, group A showed better results in reducing pain, increasing forward flexion, extension, ipsilateral lateral flexion, rotation ranges of motion, and functional disability ($p<0.05$). For contralateral lateral flexion, group A showed more improvement than group B; however, it was not statistically significant ($p>0.05$). At baseline, the mean value for group A (18.76) was less than group B's (26.20). Both groups showed almost equal effect up to the 2nd week, but in the 4th-week group, A was seen to be more successful (group A mean= 33.32 & group B mean=32.40). Similarly, for contralateral rotation, group A showed more improvement than group B, but it was not statistically significant ($p>0.05$). At baseline, the mean value for group A (42.16) was less than group B's (44.40). Group A was seen to be more successful in increasing the range after 2 week's treatment, and also, after 4 weeks, group A was more successful (group A mean= 57.72 & group B mean=54.16). Both groups showed improvements in all dependent variables, and the improvements were statistically significant within the group.

There is evidence to back up the positive effect of MET intervention when neck pain is associated with neuropathy. An RCT consisting of a sample size of 16 patients with unilateral CR was conducted, and the Effects of the post-isometric technique of MET coupled with cervical traction were compared with the effect of cervical traction without MET. More remarkable improvements were seen in all the variables in patients of the experimental group, which received MET, and this difference was statistically significant.[19] A retrospective case report of 10 unilateral cervical spondyloarthritis patients over the age of 65 years. MET with a multimodal approach was used as treatment. The patient showed improvement in pain, ranges, and disability after 6 months of follow-ups.[8] It was also observed that MET yields better results when coupled with another intervention.[8,19-21] Former studies have also shown a reduction in pain when treated with MET in patients with lateral epicondylitis (LE),[22] lower back pain (LBP) and [23] mechs. Neck pain,[21,24-26] neck pain due to MTrPs,[27] neck pain due to Latent trigger points (TrPs),[20,28,29] gastro soleus complex flexibly.[30]

Previous reports also demonstrated a lessening in disability when treated with MET in patients with neck pain due to Latent trigger points,[29] neck pain due to MTrPs,[27] mechanic pain[24-26] and LE.[22] In earlier investigations, the increase in ROMs was also seen when treated with MET in patients with neck pain due to Latent trigger points,[20,29] neck pain due to MTrPs,[27] mechanical neck pain[24,25] and LBP.[23] 6-week long follow-up case series of 20 patients in 2018 proved that MET is recommended for neck pain, disability in neck and ROMs. The rehab plan was designed with a series of five repetitions a session. The stretch stage was maintained for 10 seconds.[24] The effectiveness of METs has been examined in several studies. Similar statistically significant results for pain and NDI were yielded when chronic mech. Neck pain patients underwent MET, while the other group received static stretching. Statistical calculations manifested a remarkable difference between the two groups in terms of the changes in all three parameters. Nonetheless, the MET scores demonstrated better progress in VAS and NDI ratings than the stretching.[26] METs efficacy for mech. Neck pain (caused by latent TrPs) was inspected alone and when coupled with dry needling (DN). All dependent variables for all teams vastly improved statistically according to the single group reports. The inter-group interpretation verified combined treatment group encountered better results significantly than the individual

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implementation. In female individuals exhibiting ache, decreased ranges of DN and MET together are comparably beneficial in reducing ache and improving ranges.[20]

A study in 2014, looked into the impact of MET in addition to exercises involving deep neck flexors (DNF) against solo DNF exercises in people with no less than three months of chronic neck pain (CNP). Both MET in addition to exercises involving DNF and solo DNF exercises, showed the potential to ease pain and improve disability through the results. However, only the combination of MET plus DNF could correct forward head posture.[21] Different protocols (maximum voluntary isometric contraction, contraction time, stretch time, rest interval and reps) and different techniques (post-facilitation stretching or PIR) for MET were used in previous studies. MET was used either alone or in combination with other treatments. These researches proved MET effective for objective and subjective outcome measures for the treatment of musculoskeletal injuries with or without neuropathies. The results of these studies were consistent with this current trial results in which after 4 weeks of follow-up and 12 sessions of MET when used in combination of other treatments which was phonophoresis in this trial, improvements were observed in pain, disability and ROMs.

The findings of former trials proved phonophoresis is recommended for pain reduction[31,32,] & disability.[32] When phonophoresis was coupled with manual therapy in this study, the results were far better than phonophoresis alone. The interpretations of the results of a study on 64 females with CNP established that integrating Php with exercise rehabilitation can yield enhanced therapeutic results concerning a drop in physical symptoms, i.e., pain and disability, as well as psychological symptoms such as depression and also sleep quality in CNP patients.[32] Results of group B also suggests that phonophoresis works efficiently on cervical pain in the subacute phase. But it can also be clinically beneficial in chronic neck pain.[32] In a 2018 report issued by Saeed et al., the effectiveness of ultrasound with non-medicated aqueous gel compared to phonophoresis for managing pain caused by suffering from cervical spondylosis was assessed. According to the data retrieved through stats, individuals who experienced phonophoresis reported much less neck pain and disability than those who underwent a therapy ultrasound.[33] This evidence supports the results of this current study, i.e., phonophoresis modality is effective in reducing pain, and inflammation, thus increasing ROMs and reducing disability.

CONCLUSION

According to the present investigation, all degenerative cervical radiculopathy patients manifesting unilateral upper limb radicular complaints were treated effectively in both groups (group 1: MET & ketophp, group 2: ketophp) and showed significant recovery. However, the combination of muscle energy technique and phonophoresis in group A brought marked improvements in all possible movements of the neck (except for contralateral lateral flexion and contralateral rotation) and eased pain severity along with functional disability with treatment as compared to group B. Therefore, integrating MET, and phonophoresis is advised as a more suitable and successful strategy for treating individuals with CR in the subacute phase.

DECLARATIONS

Consent to Participate: Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.
Availability of data and materials: Data will be available on request. The corresponding author will submit all data set files.
Competing interests: None
Funding: No funding source is involved.
Authors' contributions: All authors read and approved the final manuscript.

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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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