Original Article

A randomized controlled trial on the efficacy of longwave diathermy on pain, disability and range of motion in the patients with neck pain

Um estudo randomizado controlado sobre a eficácia da diatermia de ondas longas na dor, incapacidade e amplitude de movimento em pacientes com dor cervical

Usha Panihar[1]
Kusum Sharma[2]
Shabnam Joshi[3]
Alka Pawalia[4]

[1]Corresponding author. Guru Jambheshwar University of Science & Technology (Hisar). Haryana, India. ushasportsphysio@gmail.com
[2-4]Guru Jambheshwar University of Science & Technology (Hisar). Haryana, India. dadhich444sha@gmail.com, shabnamphysio@gmail.com, alkapawalia@gmail.com

ABSTRACT | INTRODUCTION: Neck pain is a significant cause of disability worldwide, caused by various conditions like underlying diseases, mechanical and neuropathic abnormalities. Longwave Diathermy (LWD) is a therapeutic heating modality used to treat many musculoskeletal conditions. **OBJECTIVE:** To evaluate the efficacy of LWD on pain, disability, and range of motion (ROM) in neck pain. **METHODS AND MATERIALS:** The study was conducted after ethical approval from the university and registration in clinical trial registry (PTY/2022/155 & CTRI/2022/06/043033). Thirty patients with neck pain of 20-60 years were randomly allocated into two groups. The control group (n=15) performed simple home-based exercises, while in the experimental group (n=15) longwave diathermy was also given along with home exercises, 3 times/week for 2 weeks. The outcome measures like the Visual analogue scale (VAS), neck disability index (NDI), and Neck range of motion were assessed at baseline, at the end of 2 weeks (post-treatment), and after a follow-up of 2 weeks. **RESULTS AND CONCLUSION:** There was a significant improvement in pain, disability, and ROM post-intervention in the control group and experimental group. Additionally, there was a significant difference in pain after follow-up in both groups. The between-group comparison suggested that there was a significant difference for VAS, NDI, and neck extension ROM ($p<0.05$) but not for ROM in other directions. Therefore, it can be concluded that LWD is an effective therapeutic intervention for improving pain, neck disability, and neck range of motion along with neck exercises in patients with neck pain.

KEYWORDS: Diathermy. Neck Pain. Range of Motion. Visual Analog Scale. Musculoskeletal.

RESUMO | INTRODUÇÃO: A cervicalgia é uma importante causa de incapacidade em todo o mundo, causada por várias condições como doenças de base, anormalidades mecânicas e neuropáticas. A Diatermia por Ondas Longas (LWD) é uma modalidade de aquecimento terapêutico usada para tratar muitas condições musculoesqueléticas. **OBJETIVO:** Avaliar a eficácia da LWD na dor, incapacidade e amplitude de movimento (ADM) na dor no pescoço. **MÉTODOS E MATERIAIS:** O estudo foi conduzido após aprovação ética da universidade e registro em registro de ensaio clínico (PTY/2022/155 e CTRI/2022/06/043033). 30 pacientes com cervicalgia de 20-60 anos foram alocados aleatoriamente em dois grupos. O grupo controle (n=15) realizou exercícios domiciliares simples, enquanto no grupo experimental (n=15) a diatermia de ondas longas também foi administrada juntamente com exercícios domiciliares, 3 vezes/semana por 2 semanas. As medidas de resultado, como a escala visual analógica (EVA), índice de incapacidade do pescoço (IIP) e amplitude de movimento do pescoço, foram avaliadas na linha de base, no final de 2 semanas (pós-tratamento) e após um acompanhamento de 2 semanas. **RESULTADOS E CONCLUSÃO:** Houve melhora significativa da dor, incapacidade e ADM pós-intervenção no grupo controle e no grupo experimental. Além disso, houve diferença significativa na dor após o acompanhamento em ambos os grupos. A comparação entre os grupos sugeriu que houve uma diferença significativa para EVA, IIPe ADM de extensão do pescoço ($p<0,05$), mas não para ADM em outras direções. Portanto, pode-se concluir que a LWD é uma intervenção terapêutica eficaz para melhorar a dor, a incapacidade do pescoço e a amplitude de movimento do pescoço, juntamente com exercícios de pescoço em pacientes com dor no pescoço.

PALAVRAS-CHAVE: Diatermia. Cervicalgia. Amplitude de movimento. Escala visual analógica. Musculoesqueléticas.

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Introduction

Neck pain is one of the most common musculoskeletal condition and a leading cause of disability worldwide.[1] Neck pain has been reported to be the fourth major cause for years lost to disability, according to the Global Burden of Disease 2010 study.[2] The prevalence of neck pain ranges from 5.9% to 38.7% in adult population (ages 15-74). The females tend to develop neck pain more as compared to males.[3] Neck pain has been categorized into many types on the basis of duration, mechanism and cause etc. Neck pain can be acute (<6 weeks), subacute (≤3 months) and chronic neck pain (>3 months) based on duration. On the basis of mechanism, neck pain can be categorised into mechanical and neuropathic neck pain. It can also be classified on the basis of its causation i.e., primary and secondary.[2] Mechanical neck pain is of the insidious nature, and is multifactorial for instance neck strain, poor posture, anxiety, depression, sports and occupational activities.[4] While neuropathic pain is a type of pain that results from any injury or a disease that involves peripheral nervous system.[2]

In several studies, it is demonstrated that 20% of the mechanical stability of the cervical spine is contributed by the osseo-ligamentous system, which provides stabilization mainly at the end range of the posture, whereas muscles provide dynamic support in the activities in the neutral and mid-range postures.[5] The treatment mainly includes conservative and surgical treatment. Conservative treatment comprises of exercises such as strengthening and stretching exercises, home exercises and cervical collar. Other physiotherapy approaches include massage therapy, exercise, traction, soft cervical collar, spinal manipulation, acupuncture and electrotherapy such as Transcutaneous electrical nerve stimulation (TENS), Interferential therapy (IFT), Shortwave diathermy (SWD), Ultrasonic therapy and Longwave diathermy (LWD) etc. Surgical treatment incorporates cervical decompression and cervical fusion, and these procedures have been shown to have good effects compared to cervical replacement and anterior cervical decompression.[2]

LWD, or capacitive and resistive electric transfer therapy, is a type of heating electrotherapeutic modality which produces heat and improves the metabolic flow and microcirculation of the superficial and deep tissues.[6] Diathermy is the term which means ”through heating”, in which the tissues between the two electrodes gets heated up. For the generation of heat diathermy uses high frequency currents of 1,000,000 to 3,000,000 cycles per second. Longwave diathermy works at a frequency range of 0.3-1 MHZ and wavelength of 300m. The penetration range of the longwave diathermy is as deep as two inches.[7] Longwave diathermy generates oscillating electromagnetic fields (EMF), comprising both magnetic and electric fields. These fields lead to production of heat in the tissues due to rapid alternating movements of ions. At the molecular level, the LWD causes heating of the blood vessels and the muscles. The heat which is generated, gets retained due to the insulating properties of the fat tissues. The physiological effects of LWD includes reduction of pain, increased metabolic functions, increased temperature of the deep tissues, improved range of motion, decreased stiffness of the tissues and relaxation of muscle spasm.[7-8] The LWD apparatus contains a treatment head and a LWD specific cream which acts as a coupling media applied between the affected part and treatment head.[9] The LWD is most commonly indicated to treat conditions like osteoarthritis, rheumatoid arthritis, tendinitis, bursitis, capsulitis, and other conditions. It can also be used to treat the discomfort caused by the conditions like sinusitis, kidney stones, muscle spasm and neuralgia.[8] Another major indication is pelvic inflammatory disease. However, it is contraindicated in the areas of anaesthesia, pus enclosed areas, arteriosclerosis, and in malignancy cases etc.[10] There have been many studies performed to understand the effect of long wave diathermy on different conditions. In one study the effect of long wave diathermy on upper trapezius spasm was studied along with myofascial release (MFR) which concluded that the effect of LWD and MFR was satisfactory on the upper trapezius spasm.[7] In a previous study, LWD was compared with groups receiving manual massage and sham long wave diathermy for the management of delayed onset of muscle soreness (DOMS) in athletes, and it indicated no clinical difference in the Numeric Pain Rating Scale (NPRS) while there were some differences in the Patient Global Impression Scale (PGIS).[6] Furthermore, a comparative study was done to compare the effectiveness of the ultrasound therapy with MFR and LWD with MFR for pain relief

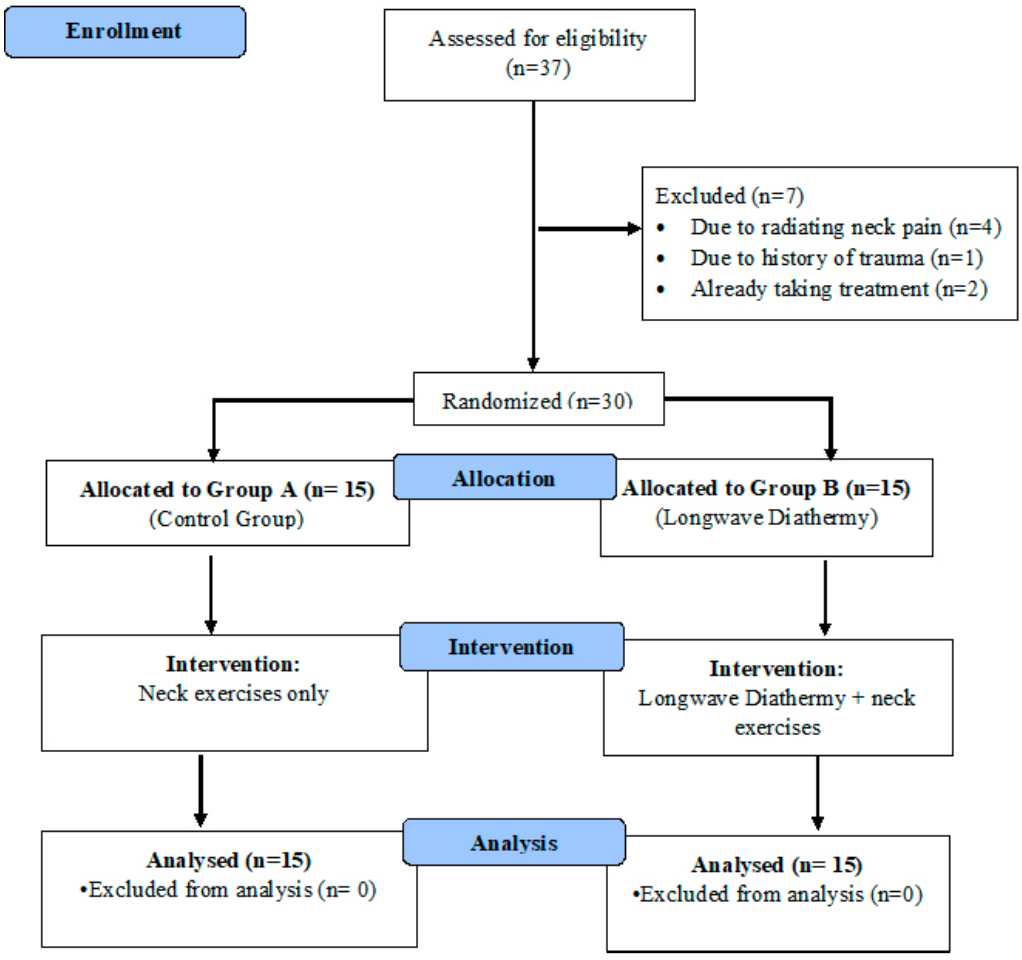
in patients with plantar fasciitis and results indicated that the LWD along with MFR was comparatively more effective than ultra sound therapy in treating plantar fasciitis.[11] Different types of treatments have been studied to treat neck pain and its related symptoms. However, there is limited evidence on effect of longwave diathermy on neck pain and disability. Therefore, the present study was conducted to examine the effectiveness of longwave diathermy on pain, disability and neck range of motion in patients with neck pain.

Materials and methods

Participants

The study was single blinded (participant blinded) randomized controlled trial conducted on patients of neck pain at Outpatient Physiotherapy Department of the University. The ethical approval for the study was taken from Departmental Ethical Committee, Department of Physiotherapy, vide letter no. PTY/2022/155. The study was also registered under Clinical Trial Registry- India (CTRI) with the registration no. CTRI/2022/06/043033. The study included neck pain patients, both male and female between the age group of 20-60 years, who had history of neck pain for at least one month. The patients undergoing some other treatment/s, patients with pain radiating to shoulder and arm, history of any recent trauma or surgery around neck, shoulder or spinal regions and any history of other musculoskeletal, neurological and cardiovascular or psychological disorders were excluded from the study.

Figure 1. Consort flow diagram



Source: The authors (2022).

Procedure

A total of 37 participants were screened as per selection criteria and only 30 participants were found suitable for the study (Figure 1). Once the study details were explained to the patients they were asked to sign the informed consent form before starting the treatment. They were randomly assigned to two groups i.e., Group A (control group) and Group B (experimental group) consisting of 15 participants in each group. At first, demographic details such as age, height, weight, and BMI were obtained from each participant. Then, outcome measures such as Neck Disability Index (NDI), cervical Range of Motion (ROM), and Visual Analogue Scale (VAS) for pain were assessed at baseline.

The participants in Group A received neck exercises which included neck range of motion exercises, neck isometrics exercises for deep neck muscles and stretching of trapezius and levator scapulae muscle. Each exercise was repeated 10 times with hold duration of 10 seconds for 3 days per week for a period of 2 weeks. The neck isometric exercises consisted of six movements such as cervical flexion, cervical extension, right and left lateral flexion, right and left rotations. For cervical flexion movement, the patient were asked to lean the neck forward a little and to place the palmer aspect of both hands on their forehead. Then, they were asked to push their head into hands, while at the same time, to resist the movement with their hands. For cervical extension movement, the patients were asked to attain a position where neck is straight. Then, they were asked to place the palmer aspect of both hands on the back of the head and to push the neck against both hands while both hands used to resist the movement. For side/lateral flexion (right and left), the starting position was same keeping neck straight. Then, the patients were asked to place the palmer aspect of one hand on the same side of the head and to push the head into hand. The hand resisting the movement at same time. For rotation (right and left), the starting position was same as it was for lateral flexion. Then, the patients were asked to place the palmer aspect of one hand on the same side of the head and to rotate the head to same side against the resistance provided by the hand.[12]

For the stretching of upper trapezius muscle, the patient was instructed to use one hand to pull the head to opposite direction while the contralateral arm extended downwards. The patients were asked to sense the elongation of muscle and to perform the stretch within pain free range only. The stretching of levator scapulae muscle was performed by using one hand to grasp the opposite side of the head and to pull the chin in the direction of axilla. The levator scapula was stretched by having one hand grasping the opposite side of the head and pulling the chin towards the direction of the armpit. Simultaneously, to maximally lengthen the muscle, the contralateral arm was lifted upwards along the wall so that the shoulder blade be rotated upwards.[13]

The participants in Group B were given Longwave Diathermy application in addition to neck exercises (same as in control group). The treatment was given in 3 sessions per week for 2 weeks. The Longwave Diathermy was applied for 10 minutes per session in continuous mode with a frequency of 1MHz. For the application of LWD, the patient was asked to sit on the chair with the hand holding the inactive electrode. The therapist was standing behind the patient, with the treatment area adequately exposed. Before starting the treatment, the patient was asked to remove any jewellery and accessories around the neck region. Then, the machine was turned on and the active electrode was moved in a circular manner over the painful area.[7]

All the participants in both groups were asked to perform the neck exercises at home. The participants were instructed to avoid the activities which requires prolonged neck flexion, to maintain proper posture, and to avoid use of thick pillows while sleeping. At the end of the second week, the assessment of outcome measures was done for all the participants. The follow up assessment of outcome measures was also done, i.e. after 2 more weeks.

Outcome measures

The outcome measures such as Neck Disability Index (NDI), cervical Range of Motion (ROM), and Visual Analogue Scale (VAS), were assessed at the baseline, at the end of intervention (after 2 weeks) and after follow-up of 2 weeks (after 4 weeks from baseline). The Pain was measured by Visual Analogue Scale (VAS), the Neck Disability was assessed by Neck Disability Index (NDI) and Neck range of motion (ROM) was measured by goniometer. The reliability and validity for VAS and NDI has been reported to be good to excellent ranging from 0.96 to 0.98 and 0.90 to 0.98 respectively.[14-18]

Statistical analysis

The objective of this research was to find out the efficacy of Longwave Diathermy in the patients with neck pain. Software version 21 of SPSS (IBM statistical package for social science) was used to perform the statistical analysis. The mean, standard deviation, t- value and p-value were calculated for all demographic data and outcome measure at baseline. Further, after the completion of data collection, results for both groups were compared using ANOVA and t- test. Within group comparison was made using ANOVA and paired t-test. While between groups comparison was done using independent t- test. The level of significance (p-value) was kept at ≤0.05.

Results

The demographic details such as age (years), weight (kgs), height (cm) and Body Mass Index (BMI), were taken at the baseline for all the patients (Table 1). The outcome measures such VAS, NDI, and neck ROM were also compared for participants of both groups for any significance at baseline using independent t-test. The comparison of both groups at baseline revealed no statistical significance for all outcome measures (Table 2).

Table 1. Baseline demographic characteristics of participants

Characteristics	Group A- Control (n=15) Mean ±SD	Group B- Experimental(n=15) Mean ±SD	t-value	p-value
Age (years)	26.6±8.72	33.2±11.6	-1.73	0.09
Weight (kgs)	57.2±11.8	60.8±12.9	-0.32	0.75
Height (cm)	161.7±9.6	162.8±8.04	-0.78	0.44
BMI (kg/m^2)	21.7±2.9	22.9±4.25	0.88	0.39

*Statistically significant at p≤0.05
Source: The authors (2022).

Table 2. Baseline comparison of outcome measure between both groups (control and experimental group)

Variable	Group-1 (Control) Mean ±SD	Group-2 (Experimental) Mean ±SD	t-value	p-value
Visual analogue scale	6.87±0.91	7.6±0.82	-1.96	0.06
Neck disability index	39.06±7.59	46.54±12.04	-2.04	0.05
Cervical - Flexion	42.6±6.94	40.38±5.64	0.98	0.33
Cervical - Extension	56.06±5.5	58.3±7.3	-0.95	0.35
Cervical Rotation – Left Side	71.59±3.9	72.5±4.00	-0.63	0.54
Cervical Rotation – Right Side	72.7±4.2	72.9±3.7	-0.13	0.90
Cervical Side Flexion – Left Side	41.6±2.6	42.28±2.2	-0.77	0.45
Cervical Side Flexion – Right Side	41.72±2.2	42.13±2.3	-0.48	0.63

*Statistically significant at p≤0.05
Source: The authors (2022).

In the control group, the results of the study revealed that there is statistically significant improvement in all outcome measures (VAS, NDI, cervical movement – flexion and extension, cervical side flexion to the left side, cervical movement to left and right side) except for cervical side flexion to the right side (Table 3). The within group comparison (Pre intervention and Post intervention comparison), the results of the study indicated that there was statistically significant difference in all the outcome measures after 2 weeks i.e., post intervention. However, when post intervention and after follow-up readings were compared using paired t-test, the results showed that there was statistically significant difference for VAS score but no significant difference found for all other outcome measures such as NDI, cervical movements – flexion, extension, cervical side flexion to left side and right side, cervical movement of rotation to left and right. Within group comparison between baseline and follow up (after 4 weeks) for experimental group indicated that there was statistically significant difference in all outcome measures except cervical movement of extension and cervical rotation to the right side (Table 4).

In the experimental group, the readings of baseline, after intervention (after 2 weeks) and after follow up (after 4 weeks), the results of the study revealed that there is statistically significant improvement in all outcome measures (VAS, NDI, cervical movement of flexion, extension, cervical side flexion to left and right, cervical rotational movement to left and right) (Table 5).

The within group comparison (Pre intervention and Post intervention comparison), the results of the study indicated that there was statistically significant difference in all the outcome measures after 2 weeks i.e., post intervention. However, when post intervention and after follow-up readings were compared using paired t-test, the results showed that there was statistically significant difference for VAS score but no significant difference found for all other outcome measures such as NDI, cervical movement of flexion, extension, cervical side flexion movement to left and right, cervical rotational movement to left side and right side. Within group comparison between baseline and follow up (after 4 weeks) for experimental group indicated that there was statistically significant difference in all outcome measures (Table 6).

In the between group comparison at the end, the results of the study indicated that there is statistically significant difference between control group and experimental group for VAS, NDI, and Cervical - Extension ROM. But there was no statistically significant difference observed for Cervical movements of flexion, Cervical side flexion movements (left side and right side) and Cervical rotational movements (left side and right side) between control group and experimental group (Table 7).

Table 3. Within group comparison of outcome measures in control group (ANOVA test)

Variables	Baseline Mean±SD	Post-intervention Mean±SD	Follow up Mean±SD	F-value	p-value
Visual analogue scale	6.6±0.9	4.1±0.8	3.2±0.9	191.85	**0.000***
Neck disability index	39.06±7.5	21.5±5.6	11.5±4.3	127.37	**0.000***
Cervical - Flexion	42.6±6.9	44.2±6.9	43.9±6.6	16.27	**0.000***
Cervical - Extension	56.06±5.5	56.06±5.01	56.9±4.9	4.91	**0.000***
Cervical Rotation – Left Side	71.6±3.9	72.8±3.5	72.8±3.9	17.57	**0.000***
Cervical Rotation – Right Side	72.7±4.2	73.9±3.5	73.6±3.5	6.79	**0.004***
Cervical Side Flexion – Left Side	41.6±2.6	43.8±1.6	43.6±1.3	17.77	**0.000***
Cervical Side Flexion -Right Side	41.7±2.3	43.1±1.7	43.4±1.8	13.91	0.15

*Statistically significant at p≤0.05
Source: The authors (2022).

Table 4. Within group comparison of outcome measures in control group (paired t test) (to be continued)

Variables	Pre Mean±SD	Post Mean±SD	Follow up Mean±SD	Pre-Post t- value (p value)	Post-Follow up- t-value (p value)	Pre-Follow up- t-value (p value)
Visual analogue scale	6.86±0.91	4.13±0.83	3.2±0.94	15.04 **(0.000*)**	5.13 **(0.000*)**	15.78 **(0.000*)**
Neck disability index	4.13±0.83	21.5±5.66	11.55±4.34	11.67 **(0.000*)**	7.32 **(0.000*)**	12.26 **(0.000*)**
Cervical - Flexion	42.65±6.94	44.23±6.16	43.94±6.57	-4 .67 **(0.000*)**	1.39 (0.18)	-3.99 **(0.001*)**
Cervical - Extension	56.06±5.51	56.96±5.01	56.89±4.9	-2.54 **(0.02*)**	0.41 (0.68)	-2.11 (0.053)
Cervical Rotation– Left Side	71.58±3.91	73.88±3.49	72.8±3.88	-6.27 **(0.000*)**	0.33 (0.74)	-4.07 **(0.001*)**
Cervical Rotation– Right Side	72.74±4.21	73.89±3.56	73.62±3.54	-3.56 **(0.003*)**	1.26 (0.22)	-2.13 (0.051)

Table 4. Within group comparison of outcome measures in control group (paired t test) (conclusion)

Variables	Pre Mean±SD	Post Mean±SD	Follow up Mean±SD	Pre-Post t- value (p value)	Post-Follow up- t-value (p value)	Pre-Follow up- t-value (p value)
Cervical Side Flexion - Left Side	41.59±2.6	43.82±1.62	43.62±1.31	-5.18 (**0.000***)	0.76 (0.46)	-3.98 (**0.001***)
Cervical Side Flexion - Right Side	41.72±2.29	43.14±1.68	43.38±1.7	-4.07 (**0.001***)	-0.72 (0.48)	-4.67 (**0.000***)

*Statistically significant at p≤0.05
Source: The authors (2022).

Table 5. Within group comparison of outcome measures in experimental group (ANOVA test)

Variables	Baseline Mean±SD	Post-intervention Mean±SD	Follow up Mean±SD	F-value	p-value
Visual analogue scale	7.6±0.8	2.6± 0.9	1.8 ±1.6	167.4	**0.000***
Neck disability index	46.5±12.04	11.10±11.14	6.1±7.15	101.4	**0.000***
Cervical – Flexion	40.4± 5.6	43.1 ± 3.7	42.9± 3.7	12.77	**0.000***
Cervical-Extension	58.3± 7.3	61.9± 5.6	62.02± 5.6	21.77	**0.000***
Cervical Rotation – Left Side	72.4± 4.0	75.01 ±1.4	75.7± 1.8	12.68	**0.000***
Cervical Rotation – Right Side	72.3± 3.6	74.9± 1.8	74.8± 2.1	8.56	**0.001***
Cervical Side Flexion - Left Side	42.3 ±2.2	44.3 ±1.1	44.4 ±1.3	23.85	**0.000***
Cervical Side Flexion - Right Side	42.1± 2.3	43.9± 0.9	44.2± 0.8	11.1	**0.000***

*Statistically significant at p≤0.05
Source: The authors (2022).

Table 6. Within group comparison of outcome measures in experimental group (paired t-test)

Variables	Pre Mean±SD	Post Mean±SD	Follow up Mean±SD	Pre-Post	Post-Follow up	Pre-Follow up
				t- value (p value)	t-value (p value)	t-value (p value)
Visual analogue scale	7.6±0.8	2.6± 0.9	1.8 ±1.6	18.27 **(0.000*)**	2.57 **(0.022*)**	13.61 **(0.000*)**
Neck disability index	46.5±12.04	11.10±11.14	6.1±7.15	9.77 **(0.000*)**	1.72 (0.11)	14.84 **(0.000*)**
Cervical – Flexion	40.4± 5.6	43.1 ± 3.7	42.9± 3.7	-3.60 **(0.003*)**	0.82 (0.42)	-3.74 **(0.002*)**
Cervical – Extension	58.3± 7.3	61.9± 5.6	62.02± 5.6	-4.56 **(0.000*)**	-0.47 (0.65)	-4.71 **(0.000*)**
Cervical Rotation – Left Side	72.4± 4.0	75.01 ±1.4	75.7± 1.8	-3.35 (0.005)	-1.09 (0.30)	-4.11 **(0.001*)**
Cervical Rotation – Right Side	72.3± 3.6	74.9± 1.8	74.8± 2.1	-2.94 **(0.011*)**	0.40 (0.70)	-3.03 **(0.009*)**
Cervical Side Flexion -Left Side	42.3 ±2.2	44.3 ±1.1	44.4 ±1.3	-5.59 **(0.000*)**	-0.60 (0.56)	-4.97 **(0.000*)**
Cervical Side Flexion - Right Side	42.1± 2.3	43.9± 0.9	44.2± 0.8	-3.107 **(0.008*)**	-1.27 (0.22)	-3.77 **(0.002*)**

*Statistically significant at p≤0.05
Source: The authors (2022).

Table 7. Between group comparison among both groups (control & experimental group)

Variables	Group A- Control (n=15) Mean ±SD	Group B- Experimental (n=15) Mean ±SD	t-value	p-value
Visual analogue scale	2.47±0.51	4.99±1.05	-8.30	**0.000***
Neck disability index	17.56±5.82	38.08±8.87	-7.49	**0.000***
Cervical - Flexion	-1.58 ± 1.31	-2.81±3.02	1.44	0.16
Cervical - Extension	-0.9±1.37	-3.66±3.11	3.15	**0.004***
Cervical Rotation – Left Side	-1.29±0.79	-2.52±2.91	1.57	0.13
Cervical Rotation – Right Side	-1.15±1.2	-2±2.63	1.12	0.27
Cervical Side Flexion - Left Side	-2.23±1.66	-2.05±1.41	-0.32	0.75
Cervical Side Flexion - Right Side	-1.42±1.35	-1.8±2.24	0.56	0.58

*Statistically significant at p≤0.05
Source: The authors (2022).

Discussion

The purpose of the study was to determine the efficacy of long wave diathermy on the neck pain, neck disability, and neck range of motion in the patients with neck pain. The results of the study revealed that there was significant improvement within the participants of control group (Group A) for all the outcome measures such as pain, neck ROM, neck disability except for neck side flexion to the right side, when pre and post intervention readings were compared. In the experimental group (Group B), those who received LWD as an intervention along with neck exercises, the results indicated that there is significant improvement in all the outcome measures when pre and post intervention readings were compared. Furthermore, there was also significant difference between pre and follow up readings which suggests that the improvement gained through provided intervention was also maintained in follow up period. The between group comparison suggested that there is more improvement in longwave diathermy group compared to control group for the VAS, NDI and neck extension range of motion, but there was no difference observed between the groups for neck flexion, side flexion and rotation to both sides. The results of the present study are in line with the study performed on patients having upper trapezius muscle spasm which revealed that there was improvement in the spasm of upper trapezius muscle after application of Longwave Diathermy for 6 days continuously.[7] Further, the results are also supported by another study which included three groups which had patients of neck pain, frozen shoulder and back pain, the results indicated that VAS readings were decreased with the application of long wave diathermy.[8]

There are some other studies which have been performed by application of LWD on different areas of body. Manigandan and Sangeetha did a study in patients with plantar fasciitis with application of longwave diathermy and the results of their study suggested that there was reduction in pain and improvement in foot functions when they applied longwave diathermy three times/week for four weeks.[11] Another study on DOMS, in the ski-mountaineering racers, suggested that there was no statistically significant difference in the Numeric Pain Rating Scale (NPRS) with the 10 minutes single sitting application of LWD and sham LWD. The reason for non-significant difference could be the one time application of longwave diathermy.[6]

The reduction of pain in the patients who received the LWD could possibly be due to stimulation of cutaneous thermoreceptors which causes production of heat leading to the obstruction of the communication of pain as it enters the associated area of the spinal cord via the pain gate mechanism. Pain relief mechanism is further facilitated by the increase in the Nerve Conduction Velocity (NCV) of the peripheral nerves due to heat. Heat produced by LWD also causes vasodilatation efflux from the affected tissue of chemical implicated as the mediator of pain such as bradykinin, serotonin and the prostaglandins. The heat also leads to the increased microcirculation and metabolism.[6,8] The reduction of pain further contributes to decreased neck disability and improved functions.

However, the reason for improvement in neck pain, disability and range of motion in control group may be explained by several studies which have been performed to assess the effects of exercises on the neck pain, disability and range of motion. Dusunceli et al. [19], in their study stated that there is relation between endurance capacity and strength of the cervical muscles on the neck pain, exercises such as isometrics and stretching exercises promote muscle strength, restoration of injured tissue, and helps to sustain normal activities of daily life. Static conventional stretching exercises were beneficial to reduce pain and improving the range of motion in patients of neck pain.[19] The reason for the non-significant difference between groups for neck range of motion in other directions may be the different age factor in both the groups and short-term application of long wave diathermy.

The future researches may determine the effect of long wave diathermy on similar age group patients. The studies may be conducted to find out the efficacy of long wave diathermy on other variables such as strength of muscles around neck etc., and long term application of LWD as a treatment method.

Conclusion

From the present study, it can be concluded that the application of two weeks of longwave diathermy is an effective method to reduce the pain, neck disability and neck range of motion (neck extension) in patients with neck pain. Therefore, Longwave diathermy can be used as an intervention for the reduction of pain and neck disability along with neck exercises.

Authors' contributions

Panihar U participated in research conception and design, data analysis and interpretation, article writing, data collection, critical review of the article, final approval of the article. Sharma K participated in the conception and design of the research, collection and/or assembly of data, writing of the article. Joshi S participated in the conception and design of the research, critical review of the article, final approval of the article. Pawalia A participated in the conception and design of the research, analysis and interpretation of data, critical review of the article and final approval of the article.

Conflicts of interest

No financial, legal or political conflicts involving third parties (government, companies and private foundations, etc.) were declared for any aspect of the submitted work (including, but not limited to grants and funding, participation in an advisory board, study design, preparation manuscript, statistical analysis, etc.).

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