A Comparative Study on the Effectiveness of Ultrasound Therapy (US) With Conventional Therapy versus Combination Therapy (Interferential Therapy (IFT) + Ultrasound Therapy(US)) with Conventional Therapy in the Management of Cervicalgia.

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***Abstract*—Introduction : Cervicalgia (neck pain) is a common musculoskeletal condition linked to poor posture, muscle imbalances, stress, and sedentary lifestyles. Physiotherapy management includes pain relief, mobility restoration, and prevention through manual therapy, therapeutic exercises, posture correction, and ergonomic advice. Electrotherapy modalities, such as Transcutaneous Electrical Nerve Stimulation (TENS), Pulsed Electromagnetic Field Therapy (PEMF), Electrical Muscle Stimulation (EMS), Ultrasound Therapy (US), and Interferential Therapy (IFT), are used to alleviate pain, reduce muscle spasms, and promote healing. Combining IFT and ultrasound therapy enhances pain relief and tissue recovery by addressing neurological and musculoskeletal aspects of neck pain. However, research on their combined effects remains limited.**

Methodology : Patients with chronic non-radiating neck pain were screened for eligibility, provided informed consent, and underwent baseline assessments, including pain intensity (DVPRS) and neck range of motion (goniometer). Treatment interventions included conventional therapy (Group I & II) with neck stretching (flexion, extension, side bending, rotation), strengthening exercises (isometric holds, chin tucks, scapular retractions, shoulder shrugs), and postural correction advice for sitting, standing, sleeping, and device use. Group I received Ultrasound therapy (1 MHz, 1 W/cm², continuous mode) for 5 minutes per session, five times per week for two weeks. Group II received Combination Therapy, where a single Interferential Therapy (IFT) electrode was placed around the neck alongside Ultrasound (US) applied to the pain site (3 MHz, 1 W/cm², pulsed mode). IFT was set at a 4000 Hz carrier frequency with a 90–120 Hz beat frequency, both applied simultaneously for 10 minutes. Treatment lasted 10 sessions over two weeks, enhancing pain relief and recovery. At the end of the treatment, each patient was re-evaluated for pain reduction and neck range of motion (ROM) using the Defense and Veterans Pain Rating Scale (DVPRS) and a goniometer. Patients receiving Ultrasound and Combination Therapy were compared to their baseline measurements.

Result : Statistical analysis utilized parametric tests as the data followed a normal distribution. Both groups showed a statistically significant reduction in pain levels ($p < 0.05$) as measured by DVPRS scores. The paired t-test revealed that Group I had a mean pain reduction of 3.73 ± 0.90 ($t = 16.04$, $p < 0.05$), while Group II showed a greater reduction of 4.67 ± 1.23 ($t = 14.09$, $p < 0.05$). An independent t-test comparing the two groups demonstrated that Group II achieved significantly greater pain relief ($t = 3.06$, $p = 0.0025$). Similarly, both groups exhibited significant improvements in neck ROM across all movement parameters ($p < 0.05$). However, independent t-tests confirmed that Group II had significantly greater increases in ROM compared to Group I ($p < 0.05$ for all 8 movement parameters), with the largest improvements observed in lateral rotation ($t = 3.42$, $p = 0.0010$) and lateral flexion ($t = 2.95$, $p = 0.0030$). These findings indicate that while both treatments are effective, Combination Therapy (IFT + US) provides superior pain relief and greater enhancement of neck ROM than Ultrasound Therapy alone.

Conclusion : The study concludes that both Ultrasound Therapy and Combination Therapy (IFT + US) significantly reduce pain and improve neck range of motion (ROM) in patients with cervicalgia. However, Combination Therapy proved to be more effective, showing greater pain reduction and ROM improvements compared to Ultrasound Therapy alone.

***Key words*— cervicalgia, neck pain, Ultrasonic Therapy, Interferential Therapy, Combination Therapy, conventional therapy.**

I. INTRODUCTION

Neck pain, also referred to as *cervicalgia*, is a prevalent and frequently encountered condition characterized by discomfort or pain in the cervical region. The term *cervicalgia* is derived from the cervical spine, which represents the uppermost segment of the spinal column situated in the neck.[13] This condition is not only common but also significant, with a widespread occurrence affecting a large portion of the global population. The implications of neck pain extend far beyond its physical discomfort, as it can substantially impair individual's daily functioning. Those affected by neck pain often report limitations in their ability to carry out routine tasks, which may result in decreased productivity, diminished engagement in physical activities, and an overall reduced quality of life. Furthermore, the burden of neck pain can extend into other aspects of life, including mental health, social relationships, and work performance.

The definition of neck pain is broad, encompassing any form of discomfort or pain located between the superior nuchal line, which is the bony prominence at the back of the head, and the spinous process of the first thoracic vertebra, situated just below the neck in the upper back. This wide-ranging definition includes various types of neck pain that may arise from different sources, such as injuries, poor posture, stress, degenerative conditions, or other underlying medical conditions. In some instances, pain originating in the neck may radiate to other areas of the body, such as the head, shoulders, upper back, and arms, a phenomenon known as referred pain.[1]

The persistence of pain can negatively affect both physical and mental health, leading to anxiety, depression, and a heightened perception of disability. The widespread prevalence of neck pain, combined with its profound impact on an individual's well-being, makes it a considerable public health issue. As such, addressing this condition requires a multifaceted approach that does not only focus on alleviating the physical symptoms but also incorporates strategies to mitigate the psychological and emotional factors that may contribute to its onset and persistence.[1]

The onset and persistence of neck pain are influenced by a variety of interconnected factors that often mirror those seen in other musculoskeletal disorders.[2][4] Key contributing factors include lifestyle choices, physical activity levels, occupational demands, posture, and underlying medical conditions. For instance, obesity is widely recognized as a significant risk factor for the development of neck pain.[2][3][4]

Psychological factors, including emotional well-being and stress, are also known to play a critical role in the onset and persistence of neck pain. Stress, for example, can lead to increased muscle tension, particularly in the neck and shoulder regions, which may exacerbate pain. Stress also tends to negatively impact posture and promote habits that can strain the cervical spine, further contributing to discomfort. Emotional factors, such as anxiety and depression, have been shown to influence the perception of pain, often heightening sensitivity to discomfort and increasing the likelihood of chronic pain development. Moreover, traumatic events, such as whiplash injuries resulting from automobile accidents, traumatic brain injuries, or injuries sustained in contact sports like wrestling, ice hockey, or football, can directly damage the cervical structures and result in both acute and chronic neck pain.[4][5][6]

Occupational factors also play an essential role in the development of neck pain. Various occupations are associated with a higher incidence of neck discomfort, particularly those involving prolonged periods of poor posture or repetitive movements. Professions such as office work, which often requires extensive computer use, as well as manual labor, where physical strain is common, and healthcare, where workers frequently engage in physically demanding tasks, are all linked to a higher likelihood of developing neck pain.[4][6]

The prevalence of neck pain is higher among women compared to men, with studies consistently indicating a greater frequency of this condition in females. While the precise reasons for this gender difference remain unclear, a combination of anatomical, hormonal, and social factors may contribute to this disparity. Women may experience greater susceptibility to neck pain due to differences in cervical spine structure, muscle mass, and hormonal fluctuations. Some research suggests that the prevalence of neck pain increases during middle age, likely due to age-related changes in the spine, such as degeneration of intervertebral discs and joint changes, as well as lifestyle factors, including reduced physical activity. However, other studies suggest that neck pain rates may stabilize or plateau during this age period, with the condition affecting individuals across various age groups relatively consistently.[7][8][9]

Neck pain, or *cervicalgia*, is a prevalent condition with various etiologies and degrees of severity. Its classification is essential for a comprehensive understanding of its causes, pathophysiology, and the most appropriate treatment interventions. One of the primary approaches for categorizing neck pain is based on its duration. acute pain lasts less than four weeks, sub-acute pain lasts up to three months, and chronic pain persists beyond three months. Chronic cases tend to be more complex and may involve structural changes in the spine or long-standing behavioral factors. Each category requires different treatment approaches, with chronic cases often needing comprehensive management plans. [4][10][11]

Another way to classify neck pain is by its etiology. Mechanical neck pain results from issues in the cervical spine and surrounding tissues, such as facet joint dysfunction, disc degeneration, or myofascial pain. Neuropathic pain arises from nerve damage or compression, as seen in conditions like radiculopathy and spinal stenosis. In some cases, pain has both mechanical and neuropathic elements, such as in degenerative disc disease, where tissue damage and nerve involvement are present [4] [12].

The diagnosis begins with a detailed medical history and physical examination. While most cases are benign and related to muscle strain or posture, clinicians must watch for red flag symptoms—such as unexplained weight loss, fever, trauma history, or neurological deficits—that could signal serious conditions like infections, fractures, or cancer [14].

To assess the impact of neck pain, tools like the Visual Analog Scale (VAS), numeric rating scales, and the Neck Disability Index (NDI) are used. These help measure pain intensity and functional limitations, allowing medical professionals to track progress and adjust treatment plans accordingly. The VAS, for instance, is a simple scale from 0 to 10 used to quantify a patient’s pain level [14].

Assessment of neck function also involves evaluating cervical range of motion (ROM), which can be measured clinically or through self-report. Physical exams often assess the ability to rotate, flex, and extend the neck. Palpation is also effective in identifying tender points or muscle spasms, particularly in cases involving myofascial pain syndrome [14] [15].

The management of neck pain primarily depends on its underlying cause. For most individuals, conservative treatments are effective in reducing symptoms. Common methods include the application of heat or cold to reduce inflammation and relieve muscle tension. Other essential components of conservative care include pharmacological treatments and ergonomic modifications, which aim to reduce strain by improving posture and body mechanics. Physical therapy is frequently prescribed to enhance muscular support and correct posture, contributing to long-term relief. Patient education is another critical aspect, helping individuals understand their condition and adopt preventive strategies to avoid recurrence [16] [17].

Exercise therapy is fundamental in managing chronic or recurrent neck pain. Its goals are to strengthen supportive muscles, improve posture and flexibility, and reduce tension. Stretching exercises enhance flexibility and reduce stiffness. For example, neck flexion, extension, side bending, and rotation stretches are commonly performed by tilting or turning the head and holding the position for 15–30 seconds. These movements reduce tightness in the neck and upper back regions [34].

Strengthening exercises focus on the neck, shoulders, upper back, and core to better support the cervical spine. Isometric exercises involve applying pressure against the hand while resisting movement, targeting specific muscle groups without straining

joints. Chin tucks improve deep cervical flexor strength, while scapular retractions and shoulder shrugs build strength in the upper back and shoulders, reducing cervical strain [34].

Postural correction plays a critical role in neck pain management, especially for individuals who spend extended periods at desks or screens. Avoiding forward head posture and maintaining proper spinal alignment while sitting, standing, and walking are emphasized to prevent chronic strain on neck muscles.

For patients with joint stiffness or limited range of motion, physical therapists may perform joint mobilization techniques. These involve controlled, gentle oscillatory movements and manual therapy aimed at increasing mobility in the cervical spine and relieving pain [20] [21] [22] [23] [24].

Thermotherapy, particularly through hot packs, is widely used in home settings for muscle stiffness and tension-related neck pain. Heat application enhances blood flow, relaxes muscles, and eases discomfort [26].

Electrotherapy techniques are often used to reduce pain, muscle spasms, and promote healing. Transcutaneous Electrical Nerve Stimulation (TENS) uses low-voltage currents to block pain signals and stimulate endorphin release, making it especially useful for chronic pain [27]. Pulsed Electromagnetic Field Therapy (PEMF) utilizes electromagnetic waves to boost circulation and healing, beneficial for persistent neck issues [28]. Electrical Muscle Stimulation (EMS) triggers muscle contractions, improving strength, reducing spasms, and correcting imbalances [29]. Ultrasound Therapy sends high-frequency sound waves into tissues to increase blood flow, reduce inflammation, and aid tissue repair, typically used for muscle strains, tendonitis, and ligament injuries with sessions lasting 5–10 minutes [30]. Interferential Therapy (IFT) combines two medium-frequency currents at the pain site to penetrate deeply and relieve pain, inflammation, and muscle spasms; sessions usually last 10–15 minutes [31] [33].

These electrotherapy methods can be more effective when combined. For instance, using Interferential Therapy alongside Ultrasound Therapy enhances both pain relief and tissue healing by targeting different layers of the affected area. This dual approach is particularly helpful for relieving trigger points and promoting recovery [32][45].

When combined, IFT and Ultrasound Therapy enhance pain relief and healing by addressing both neurological and musculoskeletal aspects of neck pain, offering a more effective and comprehensive treatment compared to each therapy alone. Combined, these therapies speed up recovery, reduce pain, and improve mobility in individuals suffering from neck discomfort. There is currently a limited body of research that thoroughly investigates and supports the therapeutic effects of Ultrasound Therapy for the treatment of neck pain. Additionally, very few studies have explored the combined effects of Ultrasound Therapy and Interferential Therapy as a treatment modality for this condition. While these therapies individually show potential benefits, the effectiveness of their combination has not been extensively validated in clinical practice for mechanical neck pains. The primary objectives of this study is to evaluate and compare the therapeutic outcomes of Ultrasound Therapy alone with the effects of a combination treatment, which includes both Ultrasound Therapy and Interferential Therapy. In addition to these treatments, the study will also incorporate hot pack application and exercise therapy, which are commonly used to alleviate neck pain and improve overall function. By examining the combined impact of these treatments, this study aim to provide valuable insights into the potential benefits of a multi-modal approach to managing neck pain [35][45].

II. METHODOLOGY

Study Area: Department of Physiotherapy, Northern Railway Central Hospital, Delhi, India, from December 2024 to March 2025.

Study Population: Patients diagnosed with non radiating neck pain by the Orthopedic department of the hospital. Thirty patients were randomly selected from the population for the study and they were assessed and divided into two groups (groups I and II). Group I contained 15 subjects and group II contained 15 subjects.

Inclusion criteria:

1. Patients of age between 30 to 60 years.
2. Unilateral neck pain persisting for more than one month;
3. Neck pain rated at least 3 on the numeric rating scale (DVPRS)
4. Local neck pain triggered by pressure
5. Restricted mobility of the neck
6. Pre-dignosed patients for non radiating neck pain

Exclusion criteria:

1. Presence of radicular diseases or radicular pain
2. Neck pain associated with cervical spine injury
3. History of neck surgery
4. Other connective tissue disorders such as systemic sclerosis or fibromyalgia

Study Period: 4 months

Sample Size: 30 patients were randomly selected based on the inclusion and exclusion criteria for the study and were divided into two groups (groups I and II) each of 15 patients.

Sample Design: This was a convenient sampling method; simple random sampling.

Study Design: It was a randomized clinical trial, comparative study.

Study variables:

1. Independent variables: Neck pain
2. Dependent variables: pain (DVPRS scale) ; neck range of motions (using goniometry)

Study Tools: (a) combination machine, (b) ultrasound machine, (c) moist heat pack, (d) DVPRS scale, (e) goniometer, (f) statistical tools—computer, calculator.

Procedure

Patient preparation and assessment:

All individuals experiencing neck pain and clinically diagnosed with chronic non-specific neck pain were screened to determine their eligibility based on predefined inclusion and exclusion criteria. Those who met the criteria and expressed a willingness to

participate were thoroughly informed about the purpose, nature, and procedures of the study, including the intervention they would undergo. The study details were explained in a clear and comprehensible manner to ensure that participants fully understood their involvement.

After providing this information, their written informed consent was obtained to confirm their voluntary participation. Following consent, demographic data such as age, sex, occupation, and residential address were collected to gain a better understanding of the participants' background.

An initial evaluation was then conducted to assess their pain levels and physical condition. Pain intensity was measured using the Defense and Veterans Pain Rating Scale (DVPRS) (fig.1.), a standardized tool for assessing pain severity. Additionally, the active range of motion (ROM) of the neck joint was evaluated using a goniometer, a device specifically designed to measure joint movement and flexibility. These baseline measurements were recorded to establish a reference point for future comparisons throughout the study.

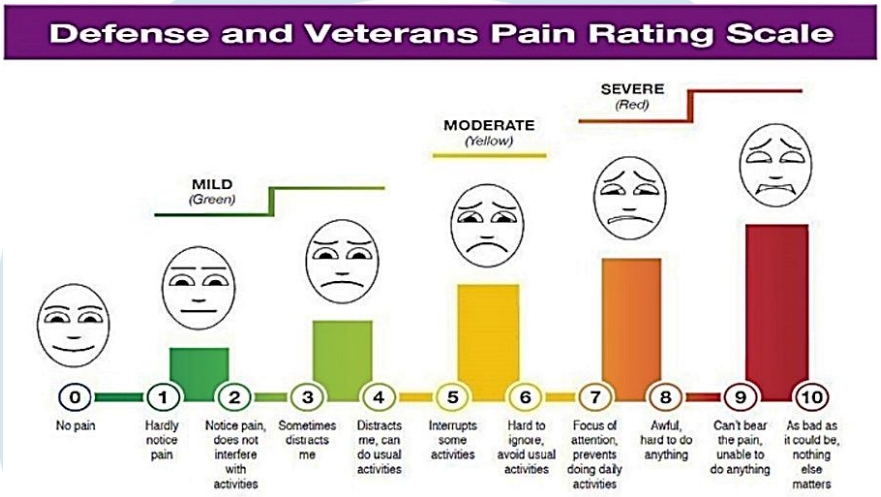


Fig.1. Defense and Veterans Pain Rating Scale

Treatment interventions:

1. Conventional therapy (Group I and II):

Neck stretching exercises:

- Neck Flexion Stretch: Gently lower your chin toward your chest, feeling a stretch in the back of your neck. Hold the position for 15–30 seconds, then return to a neutral position.
- Neck Extension Stretch: Slowly tilt your head backward, looking up toward the ceiling, to stretch the front neck muscles. Hold for 15–30 seconds then return to the starting position.
- Side Bending Stretch: Lean your head to one side, bringing your ear closer to your shoulder while keeping your shoulders relaxed. Hold for 15–30 seconds, then repeat on the other side to stretch the side neck muscles.
- Neck Rotation Stretch: Turn your head slowly to one side, trying to align your chin with your shoulder. Hold for 15–30 seconds, then repeat on the other side to stretch the neck and upper back muscles. [21][25][34]

Neck strengthening exercises:

- Isometric Neck Exercises: Apply gentle pressure against your hand while resisting movement to strengthen neck muscles. Place your hand on your forehead and push against it with your head, holding for 5–10 seconds. Repeat with your hand on the back of your head and on each side.
- Chin Tucks: Sit or stand upright, then gently tuck your chin toward your chest as if creating a double chin. Hold for 5 seconds and repeat. This exercise strengthens the deep cervical flexor muscles and improves posture.
- Scapular Retraction: Keep your shoulders relaxed and pull your shoulder blades together, squeezing them toward the spine. Hold for 5–10 seconds, then release. This helps strengthen the muscles that support the neck and upper back.
- Shoulder Shrugs: Lift both shoulders toward your ears, hold for a few seconds, then slowly lower them back down. This exercise targets the upper trapezius muscles and helps relieve neck tension. [23][25][34][39]

Postural correction advices:

- Sitting: Keep your head aligned with your spine, shoulders relaxed, and back straight. Position screens at eye level and take breaks every 30–60 minutes.
- Standing: Maintain a neutral head position with ears aligned to shoulders. Engage core muscles and avoid shifting weight to one side for long periods.
- Sleeping: Use a supportive pillow. A firm mattress helps maintain spinal alignment.
- Smartphone Use: Hold devices at eye level, use hands-free options, and avoid looking down for extended periods.
- Driving: Adjust the headrest for neck support, keep shoulders relaxed, and position the steering wheel to avoid overreaching. [42]

2. Ultrasonic therapy (Group I):

A structured ultrasound therapy program was administered for individuals with non-specific neck pain. The treatment consisted of 10 sessions over a period of two weeks, with sessions conducted five times per week, excluding weekends. Each session lasted for 5 minutes and was delivered using an ultrasound frequency of 3 MHz, in continuous wave mode, with an intensity of 1 W/cm².[36]

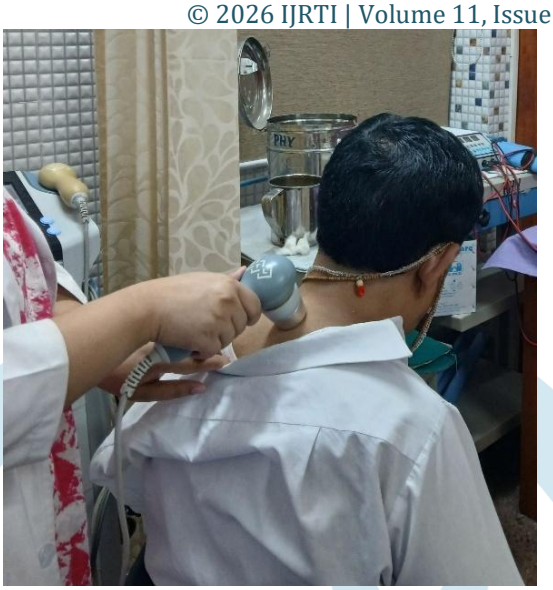


Fig. 2 : Ultrasound Therapy

3. Combination therapy (Interferential therapy + Ultrasonic therapy) (Group II):

Two interferential pad electrodes were positioned around the neck, and the ultrasound (US) treatment head was placed over the most painful area, forming a circuit with the IFT electrodes. The patient was informed about the procedure and reassured that the tingling sensation experienced should be comfortable and not unpleasant. Both ultrasound and interferential therapy (IFT) were applied simultaneously. The US therapy was set at a 3 MHz frequency, 1 W/cm² intensity, and pulsed mode (1:1) for 10 minutes, while the IFT was administered with a 4000 Hz carrier frequency, 90 Hz base frequency, 40 Hz sweep, and a 90–120 Hz beat frequency, also for 10 minutes. The treatment begin with the US head placed over the maximum pain site, forming a circuit with the IFT electrodes. Gradually, the IFT output intensity was increased until the patient felt a comfortable tingling sensation. The treatment consisted of 10 sessions over a period of two weeks, with sessions conducted five times per week, excluding weekends.[37].

Fig. 3 : Combination Therapy (US + IFT)

At the end of the treatment, each patient was re-evaluated for pain reduction and neck range of motion (ROM) using the Defense and Veterans Pain Rating Scale (DVPRS) and a goniometer. Patients receiving ultrasound and combination therapy were compared to their baseline measurements.

III. RESULTS

A total of 30 participants out of 36 screened subjects were deemed eligible for statistical analysis based on the inclusion and exclusion criteria. These participants were randomly assigned into two groups: Group I (Ultrasound Therapy Group) and Group II (Combination Therapy Group: IFT + US), as illustrated in the CONSORT diagram (Fig. 4). The mean age of the participants is presented in Table 1. In the Ultrasound Therapy Group, there were 15 participants, including 7 males and 8 females. Similarly, the Combination Therapy Group (IFT + US) also had 15 participants, consisting of 7 males and 8 females.

	Group I (n=15)	Group II (n=15)
Age in years (mean ± S.D.)	43.00 ± 12.88	44.33 ± 10.39

Table 1. mean age and standard deviation of sample population of group I and II

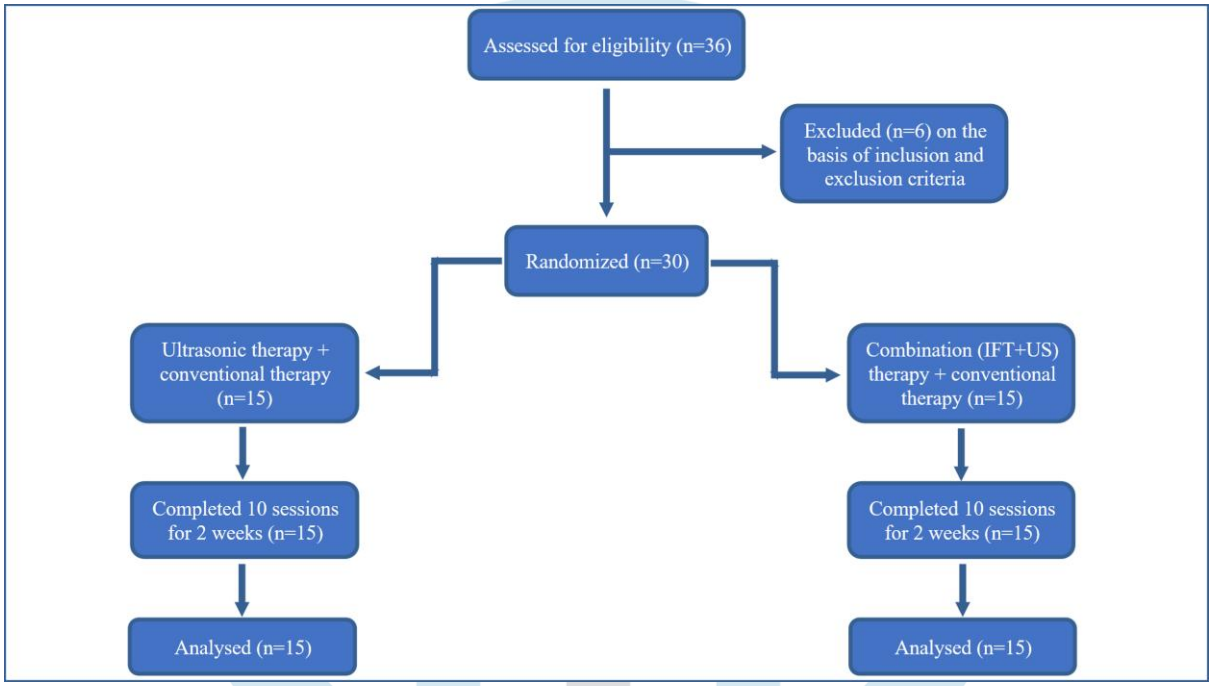


Fig. 4. CONSORT diagram / study flow chart.

A paired t-test was performed to compare the DVPRS scores within each treatment group, revealing a statistically significant reduction in pain levels ($p < 0.05$) for both groups. In the Ultrasound Therapy group, the one-tailed paired t-test resulted in a t-value of 16.04, which was significantly higher than the critical t-value of 1.761 ($\alpha = 0.05$, $df = 14$), with a p-value < 0.05, confirming a meaningful reduction in pain. Similarly, in the Combination Therapy (IFT + US) group, the one-tailed paired t-test yielded a t-value of 14.09, also exceeding the critical t-value of 1.761 ($\alpha = 0.05$, $df = 14$), with a p-value < 0.05, further confirming statistical significance in pain reduction Table 2 and Fig. 2.

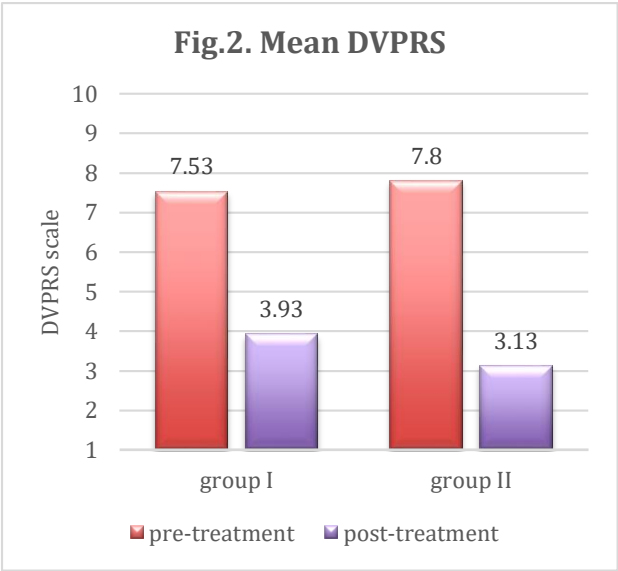
To compare the improvement in DVPRS values between the two groups, an independent t-test was conducted. The results showed a computed t-value of 3.06, which exceeded the critical t-value of 1.701 ($\alpha = 0.05$, $df = 28$), with a p-value of 0.0025 as shown in Table 3 and Fig. 3.. Since $p < 0.05$, the null hypothesis is rejected, indicating that Combination Therapy (IFT + US) leads to significantly greater pain reduction compared to Ultrasound Therapy alone.

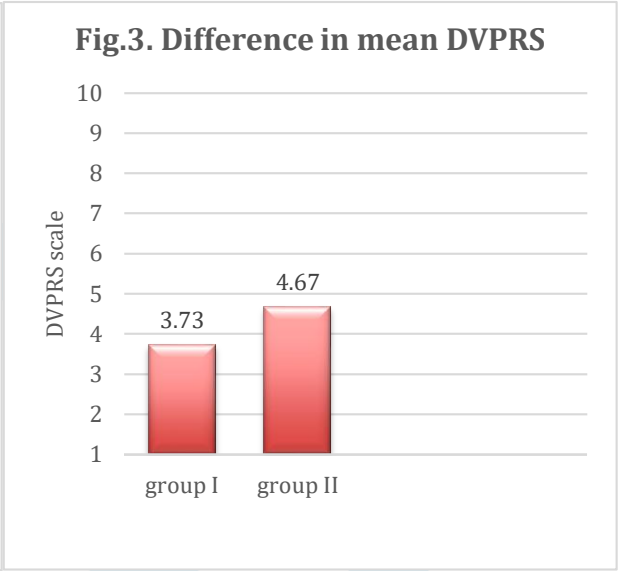
Groups	Pretreatment (mean ± S.D.)	Posttreatment (mean ± S.D.)	Improvement (mean ± S.D.)	t-value	p-value
Group I - Ultrasound therapy	7.53 ± 0.90	3.93 ± 0.71	3.73 ± 0.90	16.04	$p < 0.05$
Group II – Combination therapy (IFT + US)	7.80 ± 1.49	3.13 ± 1.07	4.67 ± 1.23	14.09	$p < 0.05$

Table 2: Pain relief (mean improvement in DVPRS values) within the two groups.

Groups	Improvement Mean	Standard Deviation	Unpaired t-test	p-value
Group I – ultrasound therapy	3.73	0.90	3.06	0.0025
Group II – combination therapy (IFT + US)	4.67	1.23		

Table 3: Pain relief (mean improvement in DVPRS values) between the two groups compared.





Similarly, a paired t-test was performed to compare the neck ROM for all movement parameters within each treatment group, revealing a statistically significant increase in neck ROM ($p < 0.05$) in both the groups. In both the groups, the one-tailed paired t-test resulted in the higher values of t-tests for each ROM parameters then the critical t-value of 1.761 ($\alpha = 0.05$, $df = 14$), with the p-values < 0.05, confirming the significant increase in neck ROMs as shown in Table 4 and Fig. 4.

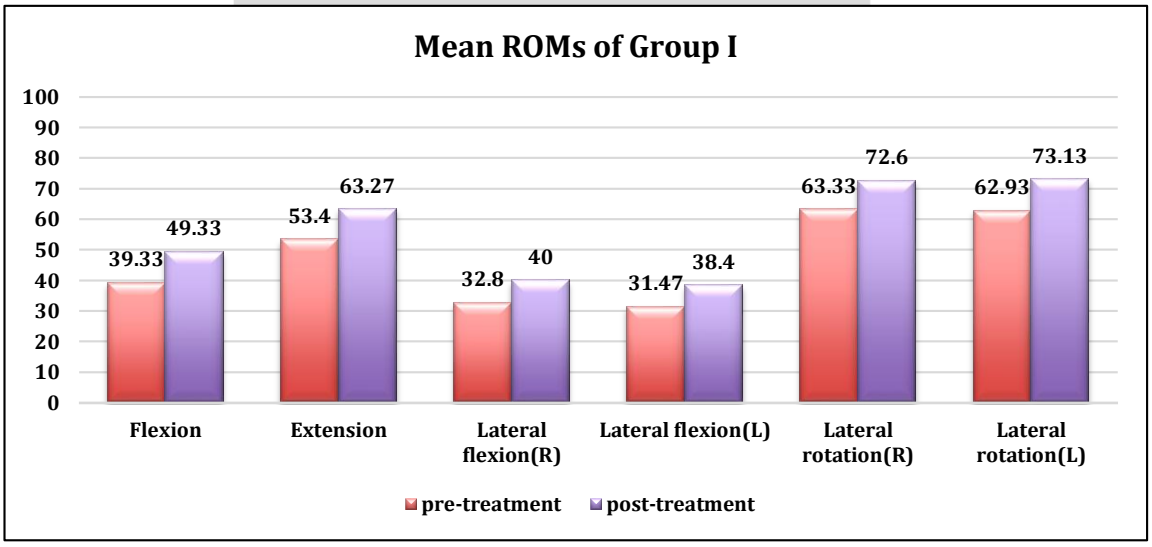
To compare the improvements in neck ROMs between the two groups, an independent t-test was applied. The test showed the computed t-values of each ROM, that are exceeding the critical t-value of 1.701 ($\alpha = 0.05$, $df = 28$), with a p-values < 0.05 for each ROM as shown in Table 5 and Fig. 5.. Since $p < 0.05$, the null hypothesis is rejected, indicating that Combination Therapy (IFT + US) leads to significantly greater increase in neck ROMs then ultrasound therapy.

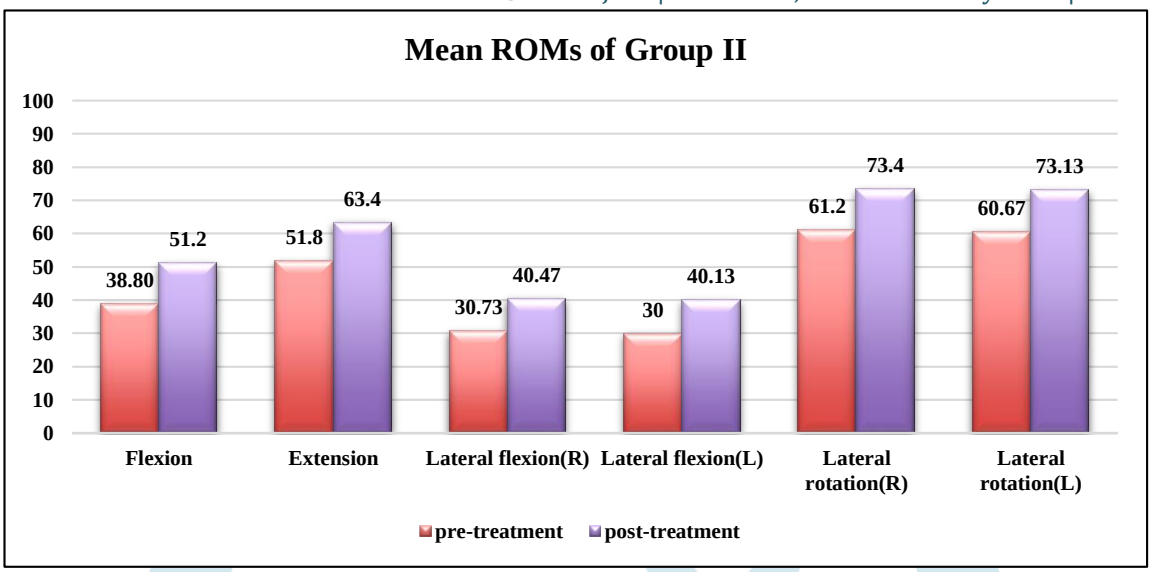
Movement parameters	Groups	Pretreatment (mean ± S.D.)	Posttreatment (mean ± S.D.)	Improvement (mean ± S.D.)	t-value	p-value
Flexion	Group I - Ultrasound therapy	39.33 ± 7.93	49.33 ± 5.40	10.00 ± 5.22	7.97	p < 0.05
	Group II – Combination therapy (IFT + US)	38.80 8.41	51.20 5.17	12.40 5.47	8.20	p < 0.05
Extension	Group I - Ultrasound therapy	53.40 ± 6.90	63.27 ± 5.10	9.87 ± 4.94	8.06	p < 0.05
	Group II – Combination therapy (IFT + US)	51.80 7.80	63.40 5.18	11.60 5.19	8.67	p < 0.05
Lateral flexion (R)	Group I - Ultrasound therapy	32.80 ± 4.91	40.00 ± 3.96	7.20 ± 4.02	6.77	p < 0.05
	Group II – Combination therapy (IFT + US)	30.73 4.74	40.47 2.97	9.73 4.29	8.49	p < 0.05
Lateral flexion (L)	Group I - Ultrasound therapy	31.47 ± 4.73	38.40 ± 3.64	6.93 ± 3.74	6.90	p < 0.05
	Group II – Combination therapy (IFT + US)	30.00 5.33	40.13 3.17	10.13 4.44	8.56	p < 0.05
Lateral rotation (R)	Group I - Ultrasound therapy	63.33 ± 6.78	72.60 ± 4.42	9.27 ± 4.26	8.66	p < 0.05
	Group II – Combination therapy (IFT + US)	61.20 7.94	73.40 4.39	12.20 4.66	10.40	p < 0.05
Lateral rotation (L)	Group I - Ultrasound therapy	62.93 ± 6.53	73.13 ± 4.30	10.20 ± 4.05	9.58	p < 0.05
	Group II – Combination therapy (IFT + US)	60.67 6.94	73.13 4.67	12.47 4.88	10.14	p < 0.05

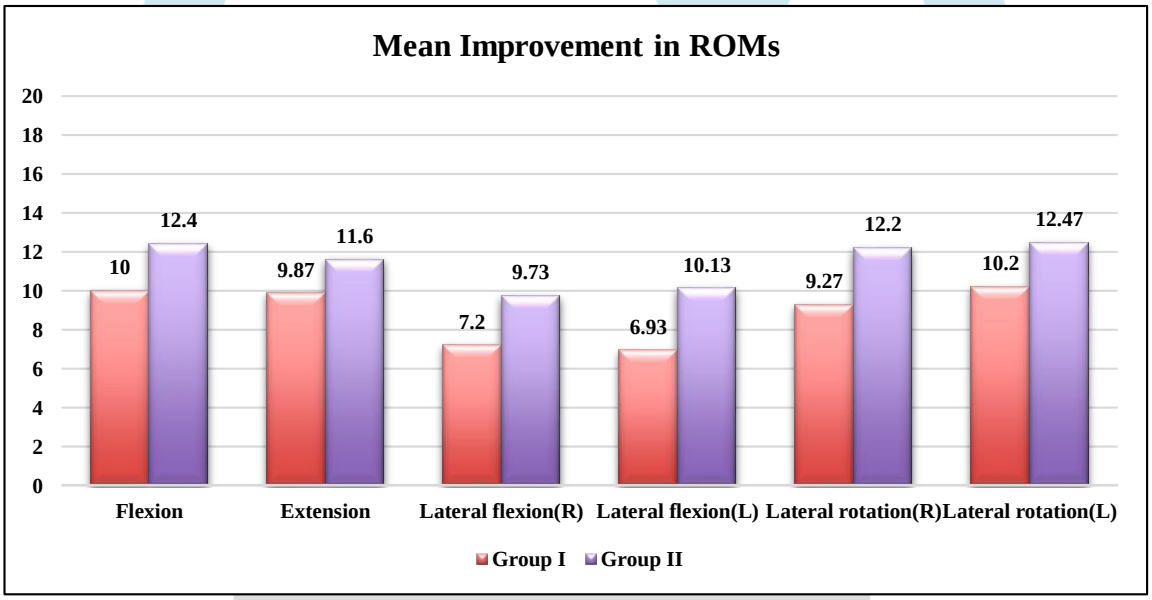
Table 4: Improvement in neck ROM within the two groups.

Movement parameters	Groups	Improvement Mean	Standard Deviation	Unpaired t-test	p-value
Flexion	Group I – ultrasound therapy	10.00	5.22	2.61	0.0070
	Group II – combination therapy (IFT + US)	12.40	5.47		
Extension	Group I – ultrasound therapy	9.87	4.94	1.92	0.0327
	Group II – combination therapy (IFT + US)	11.60	5.19		
Lateral flexion (R)	Group I – ultrasound therapy	7.20	4.02	2.82	0.0042
	Group II – combination therapy (IFT + US)	9.73	4.29		
Lateral flexion (L)	Group I – ultrasound therapy	6.93	3.74	2.95	0.0030
	Group II – combination therapy (IFT + US)	10.13	4.44		
Lateral rotation (R)	Group I – ultrasound therapy	9.27	4.26	3.18	0.0018
	Group II – combination therapy (IFT + US)	12.20	4.66		
Lateral rotation (L)	Group I – ultrasound therapy	10.20	4.05	3.42	0.0010
	Group II – combination therapy (IFT + US)	12.47	4.88		

Table 5: Improvement in neck ROM between the two groups compared.







IV. DISCUSSION

Cervicalgia is a widespread musculoskeletal disorder that affects a significant portion of the population, leading to chronic discomfort, limited mobility, and impaired daily activities. It is often associated with sedentary lifestyles, prolonged poor posture, and repetitive strain injuries [1][13]. Physiotherapy interventions, such as Ultrasound Therapy (US) and Interferential Therapy (IFT), have been extensively used to manage neck pain, aiming to reduce pain, restore function, and improve quality of life [30].

The present study was conducted to compare the effectiveness of Ultrasound Therapy (US) and Combination Therapy (Interferential Therapy + Ultrasound Therapy, IFT + US) on pain reduction and functional movements in patients suffering from neck pain. Cervicalgia (neck pain) is a common musculoskeletal disorder characterized by discomfort, restricted cervical mobility, and functional limitations, often resulting from poor posture, muscle imbalances, or prolonged static positions [1] [13]. Physiotherapy interventions, including Ultrasound Therapy and interferential therapy, have been widely used to manage neck pain and improving cervical range of motion (ROM) [30] [31]. However, there is limited research comparing the effectiveness of these modalities used individually or when used in combination along with conventional therapeutic exercises. [32].

In this study, a total of 30 patients diagnosed with neck pain were recruited and randomly divided into two groups, each consisting of 15 patients. Group 1 received Ultrasound Therapy (US) combined with conventional therapeutic exercises, while Group 2 was treated with Combination Therapy (IFT + US) along with conventional therapeutic exercises. The treatment was administered for a duration of 10 days (excluding Sundays), ensuring consistency in the intervention provided to both groups. The primary outcome measures used to assess treatment effectiveness included the Defense and Veterans Pain Rating Scale (DVPRS) for pain assessment and neck range of motion (ROM) in all movement planes (flexion, extension, lateral flexion, and rotation). These measurements were recorded before and after the intervention period for both groups to evaluate the impact of the treatments.

The results of the study revealed that both groups demonstrated statistically significant improvements in pain reduction and cervical ROM across all movement parameters ($p<0.05$) after 10 days of treatment. Patients in both Group 1 (US + exercises) and Group 2 (IFT + US + exercises) reported a decrease in pain intensity and an improvement in cervical mobility, suggesting that both treatment approaches are beneficial in managing neck pain. However, the findings also indicated that the improvements were more pronounced and statistically significant in the Combination Therapy (IFT + US) group compared to the other group. This suggests that adding IFT to US enhances treatment efficacy, leading to better outcomes in terms of pain relief and functional movement restoration.

Ultrasound Therapy is a well-established physiotherapy modality that utilizes high-frequency sound waves to penetrate deep tissues, generating both thermal and non-thermal effects that aid in pain relief, improved blood circulation, reduced muscle stiffness, and enhanced tissue healing [38]. Several studies have demonstrated that Ultrasound Therapy, when combined with therapeutic exercises, significantly enhances rehabilitation outcomes.

A study was conducted that investigated the impact of Ultrasound Therapy with cervical exercises and found significant reductions in pain intensity, along with improvements in cervical range of motion (ROM) and functional mobility in neck pain patients [39]. Similarly, there is an another study that conducted a randomized controlled trial and reported that the mechanical and thermal effects of Ultrasound Therapy helped relax muscles and increase tissue extensibility, making it easier for patients to engage in strengthening and mobility exercises. This suggests that Ultrasound Therapy serves as a valuable adjunct to active rehabilitation programs [38].

Furthermore, a comperative study was done that compared Ultrasound Therapy alone with Ultrasound Therapy combined with therapeutic exercises and found that patients in the combined treatment group experienced superior long-term functional recovery and lower recurrence rates of neck pain symptoms [40]. These findings are further supported by other studies, who emphasized the importance of strength and endurance training for the cervical and upper back muscles, stating that when integrated with Ultrasound Therapy, these exercises contribute to better pain relief, improved posture, and enhanced mobility [41].

Additionally, many other studies were also presented that analyzed multiple clinical trials or case studies and concluded that Ultrasound Therapy alone provides short-term pain relief, but its long-term effectiveness is significantly enhanced when paired with an active exercise program. While Ultrasound Therapy with exercises has been shown to be effective, research suggests that adding Interferential Therapy (IFT) to the treatment plan may yield even greater benefits. A study was conducted in order to compare IFT treatment with placebo treatments, that concluded that IFT significantly decreased neck pain intensity and improved ROM, suggesting that its ability to modulate pain perception makes it a valuable treatment for neck pain. IFT is a form of electrotherapy that uses medium-frequency electrical currents to penetrate deeper tissues, promoting pain reduction, muscle relaxation, and improved neuromuscular control.

A systematic review and meta-analysis reported that the analgesic effects of medium-frequency interferential current therapy (IFT), when combined with Ultrasound Therapy (US), are significantly enhanced due to the thermal and mechanical effects of ultrasound, resulting in greater pain reduction and improved cervical function [45]. Supporting this evidence, studies evaluating Combination Therapy (IFT + US) in conjunction with therapeutic exercises demonstrated superior outcomes in pain relief, mobility, postural alignment, and overall functional recovery compared to Ultrasound Therapy with exercises alone [32,35]. These benefits are attributed to complementary physiological mechanisms, where Ultrasound Therapy facilitates deep tissue heating, reduces muscle stiffness, enhances blood circulation, and accelerates tissue healing, while Interferential Therapy stimulates deep nerve structures, promoting pain modulation, muscle relaxation, and neuromuscular re-education [35]. Furthermore, IFT has been shown to enhance neuromuscular activation, enabling more effective participation in therapeutic exercises, thereby improving strength, endurance, and postural control, which contributes to long-term functional improvements and reduced recurrence of neck pain symptoms [31,32].

These findings highlight the greater therapeutic benefits of integrating multiple electrotherapy modalities with structured exercise programs, suggesting that Combination Therapy (IFT + US) with exercises is a more effective approach for managing chronic non-specific neck pain compared to Ultrasound Therapy with exercises alone.

V. Conclusion

The study concludes that both Ultrasound Therapy (US) and Combination Therapy (Interferential Therapy + Ultrasound, or IFT + US) are effective in reducing pain and improving neck range of motion (ROM) in patients with chronic non-specific neck pain. However, Combination Therapy proved to be more effective, as patients who received IFT + US experienced greater pain relief and more significant improvements in mobility compared to those who underwent Ultrasound Therapy alone. This suggests that the combined effects of Interferential Therapy and Ultrasound Therapy work synergistically to enhance treatment outcomes, making Combination Therapy a more effective option for managing chronic neck pain and improving functional movement.

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