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COMPARATIVE EFFECTS OF INTERFERENTIAL THERAPY VERSUS SHORTWAVE DIATHERMY COMBINED WITH EXERCISE ON PAIN AND FUNCTION IN PATIENTS WITH KNEE OSTEOARTHRITIS: A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Background: Knee osteoarthritis (KOA) ranks among the most common chronic joint diseases globally. By enhancing local blood flow and tissue metabolism, CSWD aids in eliminating inflammatory agents and metabolic waste while improving the delivery of oxygen and nutrients to the affected areas. The study aims to compare the efficiency of interferential current therapy and shortwave diathermy along with exercise in improving functional activity and decreasing the pain in patients who have knee osteoarthritis grades 2 and 3. **Methods:** A total of 20 patients were recruited and assigned randomly into two groups (A and B) by doing a randomized controlled trial. Group A received Interferential therapy while Group B received Shortwave Diathermy in a continuous mode; both groups were given the same home exercise program for knee osteoarthritis. The Intervention duration was for 2 weeks with 5 consecutive days per week for both groups, resulting in 10 sessions of treatment per patient. Pain (VAS) and function (WOMAC) were evaluated on the first and last day of the therapy. T-tests for paired and independent samples were used for statistical analysis. **Results:** Paired t-test showed improvement in pain VAS and function ability WOMAC in both the groups; however, the changes are not statistically significant ($p>0.05$). Between group comparison using an independent t-test revealed that group A demonstrated greater mean improvement in WOMAC (9.70±5.01) and VAS (3.30 ± 1.34) scores compared to group B (WOMAC: 8.30 ± 5.54; VAS: 2.60 ± 1.51). However, the difference between groups was not statistically significant (WOMAC: $p = 0.561$; VAS: $p = 0.286$).**Conclusion**: Both interferential therapy and shortwave diathermy showed improvement in functional ability in patients with knee osteoarthritis. However, interferential therapy demonstrated a relatively greater reduction in pain also, although the difference was not statistically significant.

Keywords: Knee osteoarthritis, Interferential therapy, shortwave diathermy, WOMAC, VAS

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INTRODUCTION

Knee osteoarthritis (KOA) ranks among the most common chronic joint cconditions globally. It stands out as the leading form of OA, characterized by significant rates of illness and disability. With an aging population and increasing life expectancy, KOA not only affects patients' quality of life but also poses a challenge to global public health.[1]

The cause of OA remains unclear, and its pathophysiology is intricate. Joints that endure increased stress and activity are often impacted. The knee joint is particularly susceptible to OA, as it is the most complex joint in the human body and experiences the greatest strain of any joint.[1]

Osteoarthritis (OA) can be assessed through clinical, radiographic, and pathological methods. The Kellgren– Lawrence (KL) radiographic grading system, along with its atlas, has been the most employed method for defining radiographic OA for over four decades. This comprehensive joint scoring system Categorizes OA into five stages, from 0 to 4. A clear osteophyte indicates OA (Grade≥2), while more advanced stages are characterized by the likely subsequent development of joint space narrowing,sclerosis, cysts, and eformity. 2However, not every patient with joint complaints has radiographic OA, andnot every patient with radiographic OA has a clinical disease.

As a result, a range of pathological, clinical and radiographic techniques must be used to diagnose OA.2 Interferential current therapy (IFC) is an emerging electrotherapy technique for treating knee osteoarthritis. This method uses medium-frequency alternating currents that intersect to create interference, resulting in a low- frequency current called amplitude- modulated frequency, which offers an additional benefit.3

Frequencies that are modulated by amplitude can penetrate tissues more effectively and may provide pain relief. Wearable IFC devices are being created due to their ease of use.[3]

IFT is a popular treatment for pain and dysfunction associated with musculo-skeletal disorders. Interferential electrotherapy with amplitude modulation at low frequencies reaches deep muscles and nerves, stimulates voluntary muscles, promotes an increase in peripheral blood flow, accelerates bone healing, and reduces pain. There is evidence that Interferential Therapy (IFT) may inhibit the nociceptive stimulus, possibly due to the stimulation of large diameter afferent fibres that inhibit the entrance of algid stimuli into the posterior horn of the medulla through small diameter afferent fibres.[4]

According to Brenda Savage590-100 Hz is optimum for sensory nerves, and 130 Hz is said to affect the nociceptive system. Logically combining both these thoughts, a beat frequency between 90- 130 Hz as proposed by Watson, can be an effective dosage for acute pain. Frequency between1-5 Hz is said to activate opioid mechanisms with the release of β-endorphin and encephalin, thereby producing analgesia. According to BrendaSavage5, 0-5Hz is the optimum frequency for sympathetic fibers. The sympathetic nervous system is an essential trigger of intrinsic opioid analgesia within the injured peripheral tissue. So if both the theories are to be followed, logically these frequencies set as beat frequency can be effectively used for

relief of chronic Pain. 6

Continuous short-wave diathermy (cSWD) is generally used for its thermal effects, whereas pulsed short-wave diathermy (pSWD) is used for its athermal effects. Pain reduction is one of the most important effects of diathermy, although its physiological basis is poorly understood.

Heating may reduce pain by promoting vasodilatation and efflux of pain mediators such as bradykinin, serotonin, and prostaglandins from the affected tissue. [7]

Another possible mechanism of action is the inhibition of nociceptive transmission by the activation of A- alpha and A-beta fibers or by the stimulation of cutaneous thermo receptors; this mechanism, known asgate control, blocks the transmission of pain as it enters the spinal cord. In addition, muscle spasm due to musculoskeletal pain is often reduced by heat and this in turn can contribute to decrease the pain.[7]

In continuous mode, shortwave diathermy delivers uninterrupted electromagnetic waves, resulting in a significant thermal effect within the tissues. Continuous energy emission causes molecular vibration and friction, which increases the tissue temperature. This increase in temperature leads to several physiological responses, including vasodilation, increased blood flow, enhanced metabolic activity and increased extensibility of connective tissues. These physiological effects contribute to pain reduction, improved joint flexibility and accelerated tissue healing.[8]

The therapeutic effects of continuous shortwave diathermy are particularly useful for chronic musculoskeletal conditions, such as knee osteoarthritis. By increasing local circulation and tissue metabolism, CSWD facilitates the removal of inflammatory mediators and metabolic waste products while enhancing the supply of oxygen and nutrients to the affected tissues. This process can decrease joint stiffness and improve functional movements. Additionally, the thermal effects produced by CSWD elevate the pain threshold of nerve endings and reduce muscle spasm, thereby contributing to analgesia in patients with degenerative joint diseases.9

Research studies have demonstrated the beneficial effects of shortwave diathermy in patients with knee osteoarthritis. For example, a clinical study by Jan et al.(2006)10reported that repeated shortwave diathermy, treatments significantly reduced synovial sac thickness and knee pain in individuals with knee osteoarthritis, suggesting a reduction in joint inflammation following therapy.

This study aims to compare the effects of Interferential therapy and shortwave diathermy combined with exercise in patients with knee osteoarthritis grade 2 and 3.

AIM: To compare the efficacy of interferential current therapy and shortwave diathermy with exercise in reducing the pain and improving the functional activity in patients with knee osteoarthritis grade 2 and 3.

Objectives:

1. To compare the effectiveness of interferential therapy and shortwave diathermy on pain reduction in patients with knee osteoarthritis (grade2 and 3) by using the VAS

scale.

2. To compare the effectiveness of interferential therapy and shortwave diathermy in improving functional activity by using WOMAC scale in patients with knee osteoarthritis (grade2 and 3).

3. To determine which modality is more effective for short-term and/or long-term management of knee osteoarthritis.

MATERIAL AND METHOD

This research involves a randomized controlled trial that evaluates the impact of Interferential Therapy (IFT) versus Shortwave Diathermy Therapy (SWD) on pain relief and functional activity in individuals with knee osteoarthritis (OA). All participants provided informed and written consent. A total of 20 individuals were enrolled and randomly divided into two groups for duration of 2 weeks.

- Group A (IFT Group) was treated with Interferential Therapy in conjunction with a standard exercise regimen for knee osteoarthritis.
- Group B (SWD Group) received Shortwave Diathermy alongside the identical standard exercise protocol for knee osteoarthritis.

This study was carried out in the Physiotherapy Department at Northern Railway Central Hospital, New Delhi. A total of 10 patients in Group A, who underwent Interferential Therapy along with exercise regime, and 10 patients in Group B, who received Shortwave Diathermy along with exercise regime, were assessed over a 6-month period (2025-2026).

Inclusion Criteria

1. Patients diagnosed with knee osteoarthritis (OA) grade 2 or 3 based on the Kellgren-Lawrence classification.
2. Age range: 35–75years.
3. Both male and female patients.
4. Presence of knee pain for at least 2-3 months.
5. Willingness to participate and provide informed consent.
6. Ability to perform the prescribed standard exercise protocol.

Exclusion Criteria

1. History of knee surgery or joint replacement.
2. Presence of any inflammatory arthropathy.
3. Any recent trauma or injury to the knee within the last 6 months.
4. Use of corticosteroid injections or other intra-articular treatments within the past 3 months.
5. Presence of metal implants, cardiac pacemakers or malignancy or any other contradictions for shortwave diathermy and Interferential therapy.
6. Pregnant or lactating women.

Outcome Measures

Outcome measures included pain intensity assessed using the Visual Analogue Scale (VAS) and functional activity measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scale.

Investigations

To confirm the diagnosis and severity of knee osteoarthritis, the following investigations were reviewed:

- Radiographic Assessment (X-ray of the knee

joint): Used to classify OA severity based on the Kellgren-Lawrence grading system.

• Baseline WOMAC Score (Western Ontario McMaster and Universities Osteoarthritis Index):

• VAS scale (Visual Analogue Scale)

Method of selecting subjects:

A total of 20 patients diagnosed with knee osteoarthritis by the orthopedic department of the hospital were recruited for the study. After obtaining informed consent, and receiving an explanation of the study, including aims, objectives with possible risks and benefits, participants were randomly allocated into two groups:

Group A (IFT group) and Group B (SWD group), with 10 patients in each group. Simple randomization was carried out using a computer-generated random number table.

The study was approved by the ethical and research committee of the Northern Railway Central Hospital.

Treatment Protocol

Intervention duration and Frequency:

- The study duration was for 2 weeks with 5 consecutive days per week for both groups, resulting in 10 sessions of treatment per patient.
- In addition to the therapy sessions, both groups followed a standardized exercise protocol for knee osteoarthritis, performed daily throughout the study period. Before conducting the treatment, the patients of osteoarthritis of knee were evaluated by using an evaluation format. Patients were assessed on the first day before treatment and at the end of the 10th day for following;

a) Pain evaluation by visual analogue scale

b) WOMAC Assessment

Group 1: Interferential therapy (IFT) In this group, patients underwent interferential therapy (IFT) targeting the affected knee joint. Patient Position: Supine Lying Technique: Four interferential pad electrodes were positioned around the injured knee. Patients were informed that they would experience a tingling sensation, which should not be Uncomfortable. Interferential dose: Frequency = 4000 Hz Base = 90Hz, Sweep = 40Hz, AMF/Beat Frequency = 90-130 Hz Quadripolar / Two channel Duration = 15 minutes. IFT was activated (parameters as specified). The IFT output intensity was gradually increased until the patient experienced the 'normal' tingling sensation. (Lifecare system LCS-152 V3-128-1022)

Group2: Shortwave diathermy (SWD): Patients in this group received shortwave diathermy on the affected knee joint. SWD was administered with the patient sitting on a wooden chair; knees bent at a 90° angle. Electrodes (12 cm in diameter) were placed parallel to the knees and the treatment was delivered in continuous mode (frequency = 27.12 MHz), thermal dose, for 15 minutes per session over10 sessions. (Life care system, LCS-103D). Exercise protocol for both groups: Both groups were given the same home exercise program for knee osteoarthritis. The exercise was planned as three sets of 10 repetitions.

The exercises were included:

1. Quadriceps isometric exercise: this exercise uses to improve quadriceps muscle activation with minimal joint loading, particularly useful in painful stages of OA. Procedure – patient will

lie in supine position with both lower limb in extended position. The patient is instructed to contract the quadriceps muscle by pressing the knee downward into the surface. The contraction is held for 10-15 seconds, followed by 2-3 seconds of rest.

2. Straight Leg Raise (SLR): this exercise is used to strengthen the quadriceps muscle without imposing the shear stress on the tibiofemoral joint. Procedure - the patient lies in a supine position with one knee flexed to 90 degree, and the test leg (exercising leg) is fully extended. Then the patient instructed to lift his leg to approximately 30-40 degree. And then the patient is asked to maintain this position for up to 10-15 seconds.

3. Heel slide exercise: this exercise is used to increase the knee flexion range of motion and to reduce stiffness. Procedure: In a supine lying position, the patient slowly slides the heel towards the buttocks to achieve pain- free knee flexion. The position is held for 2-3 seconds, after which the limb returns to its initial position.

4. Hamstring self-stretch exercise: This exercise is done to improve the flexibility of posterior thigh muscles, thereby reducing posterior knee tightness and improving Gait biomechanics. Procedure: the patient sits on the floor with one leg extended and the other bent. Keeping the spine straight, they lean forward from the hips toward the toes until gentle stretch is felt along the back of the thigh. The knees remain fully extended throughout Stretch. The patient is instructed to hold this position for 10-15 second, then return to the initial position.

5. Calf self-stretch exercise: this exercise is used to improve the flexibility of the Gastrocnemius and soleus muscles. Procedure: the patient sits on the floor with the target leg extended and the knee straight. A towel or strap is looped around the foot while holding both the ends firmly with the hands. The patient gently pulls the towel toward themselves to dorsiflex the ankle until a stretch is felt in the calf. The stretch is maintained for 10-15 seconds, then repeated.

RESULT AND OBSERVATIONS

The whole study was conducted at the Northern Railway Central Hospital's Physiotherapy Department in New Delhi. A total of 20 participants diagnosed with knee osteoarthritis grade II and III according to the Kellgren– Lawrence classification was recruited for the study. The participants were randomly Allocated in to two groups, with 10 participants in each group:

- Group A: Interferential Current Therapy (IFT) + Exercise
- Group B: Shortwave Diathermy (SWD) + Exercise

The sample size was considered adequate to conduct pre- and post- intervention comparisons within groups and to evaluate the comparative effects of the two treatment modalities. The treatment protocol for each participant was designed for 2 weeks with five consecutive sessions per week. The data collected from both groups were analyzed statistically by using IBM SPSS software (version 30.0). Differences of pain intensity and functional activity were evaluated by subtracting the pre and post treatment values of the WOMAC and VAS scores. Appropriate statistical tests were applied according to the need for the collected data. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. The results were expressed as

mean ± standard deviation (SD) for continuous variables. The Shapiro–Wilk test was used to assess the normality of the data.

A paired sample t-test was used to compare baseline and post-treatment, Values within each group to determine the effectiveness of the intervention. An independent sample t-test was used to compare the mean changes between Group A (IFT + exercise) and Group B (SWD + exercise) in order to determine which treatment modality produced greater improvement. Level of Significance of p-value less than 0.05 ($p<0.05$) was considered statistically significant. The following were the results of this analysis:

1. Descriptive analysis

A total of 20 participants diagnosed with knee osteoarthritis (grade 2 and 3) were included in this study. The descriptive statistics for baseline, post-treatment, and change scores are presented below: The mean baseline WOMAC score was 8.25±5.18, which reduced to 7.60± 4.69 following treatment, indicating improvement in functional ability after the intervention. Similarly, the mean baseline VAS score was 3.05 ± 1.23, while the post-treatment mean score was 3.10 ± 0.97. The calculated VAS change score was 2.95 ± 1.43, indicating a reduction in pain levels following treatment. Overall, descriptive analysis suggests improvement in both pain and functional outcomes after the treatment protocol.

1. Normality Testing

For WOMAC Change, value was 0.316 ($p > 0.05$), indicating that the data followed a normal distribution.

For VAS Change, value was 0.038 ($p < 0.05$), indicating that the data deviated slightly from normal distribution.

The normality analysis suggests that the WOMAC change scores were normally distributed, whereas the VAS change scores showed a slight deviation from normality. However, considering

the sample size (n = 20) and robustness of parametric tests, further analysis using paired t-tests and independent t- tests was considered appropriate for comparing pre- and post-treatment outcomes.

2. Paired t-test Analysis (within group) IFT Group

a. WOMACscoreimprovedfrom7.20 ±4.41 to 6.10± 4.53 t (9) =0.656,p>0.05

b. VASscoredecreasedfrom2.90±1.10 to 2.60 ± 0.84 t (9) =0.709, p>0.05 SWD Group

a. WOMAC score improved from 9.30 ± 5.89 to 9.10 ± 4.58 t(9)=0.242,p>0.05

b. VAS score slightly increased from 3.20 ±1.39 to 3.60 ± 0.84 t(9)=-0.840,p>0.05

Although none of the results were statistically significant ($p > 0.05$), but the IFT group still demonstrated slightly more clinical improvement compared to the SWD group.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
WOMACchange	SWD	10	8.30	5.539	1.752
	IFT	10	9.70	5.012	1.585
VASchange	SWD	10	2.60	1.506	.476
	IFT	10	3.30	1.337	.423

Table1: Group Statistics

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
WOMACchange	Cohen's d	5.282	-.265	-1.142	.619
	Hedges' correction	5.516	-.254	-1.094	.593
	Glass's delta	5.012	-.279	-1.158	.614
VASchange	Cohen's d	1.424	-.492	-1.376	.406
	Hedges' correction	1.487	-.471	-1.318	.389
	Glass's delta	1.337	-.523	-1.418	.398

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control (i.e., the second) group.

Table2: Independent Sample Test

Independent Samples Test

		t-test for Equality of Means							
				Significance				95% Confidence Interval of the Difference	
		t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
WOMACchange	Equal variances assumed	-.593	18	.280	.561	-1.400	2.362	-6.363	3.563
	Equal variances not assumed	-.593	17.823	.280	.561	-1.400	2.362	-6.366	3.566
VASchange	Equal variances assumed	-1.099	18	.143	.286	-.700	.637	-2.038	.638
	Equal variances not assumed	-1.099	17.754	.143	.286	-.700	.637	-2.039	.639

Table3: Independent Sample effect

DISCUSSION

This study compared the effects of interferential current therapy (IFT) and shortwave diathermy (SWD) combined with exercise on pain and functional abilityinpatients with knee osteoarthritis grades2 and 3.The findings of the study demonstrated that both treatment groups showed improvement in functional ability, as assessed by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), after the two-week intervention period. In the IFT group, there was a reduction in both mean VAS (3.30 vs 2.60) and mean WOMAC (9.70 vs 8.30) scores, indicating improvement in pain and function, while the SWD group showed comparatively smaller changes, with minimal improvement in functional ability and slight variation in pain scores.

Although the IFT group demonstrated greater mean improvement than the SWD group, the results of both within- group (paired t-test) and between-group (independent t-test) analyses were not statistically significant ($p>0.05$). This means that although patients did get better clinically, the difference was not strong enough to be considered statistically significant. This suggests that the study conditions may not have been sufficient to demonstrate a Significant difference. One of the main reasons for this could be the small sample size of the study. With only 20 participants, it becomes difficult to detect statistically significant changes, even if real improvements are present.

Another important factor is the short duration of this study. Knee osteoarthritis is a long-term chronic condition and a treatment period of only two weeks may not be sufficient to produce major measurable changes. Many physiotherapy studies have shown better results when interventions are applied over longer periods, such as 4 to 8 weeks. Another possible reason is the natural variation in pain perception between individuals. Pain is a subjective experience that can be influenced by many factors, such as mood, daily activity levels, and individual tolerance.

This variability can affect the consistency of the results, especially when using tools such as the VAS. In addition, both groups in this study received exercise therapy and electrotherapy. Since exercise itself is highly effective in improving strength, mobility, and function in knee osteoarthritis, it may have contributed significantly to the improvements seen in both groups, thereby reducing the visible differences between IFT and SWD.

The findings of this study are generally consistent with those of previous research. Studies by Hurley et al. Have demonstrated thatcombining electrotherapy with exercise can enhance functional outcomes in individuals with musculoskeletal conditions.[11]

Similarly, Bjordal et al. reportedthat electrical Stimulation moda

On the other hand, shortwave diathermy has been shown to improve circulation, reduce joint stiffness and promote tissue healing through deep heating effects, as described by

Lehmann.[13]

However, several studies and clinical guidelines, including those from the Osteoarthritis Research Society International (OARSI), emphasize that exercise therapy alone plays a central role in improving the function, which may explain why both groups in the present study showed improvement regardless of the electrotherapy modality used.[14]

At the same time, systematic reviews such as those by France et al. have highlighted the importance of exercise therapy in improving outcomes in knee osteoarthritis.[15]

In summary, when comparing the two groups, the IFT group showed a relatively greater improvement in both pain and function than the SWD group. This suggests that IFT may have a slight advantage, possibly due to its mechanism of action, which includes pain modulation through the gate control theory and stimulation of endogenous pain-relieving mechanisms. In contrast, SWD mainly works through deep heating, improving circulation and reducing stiffness, which may take longer to show noticeable effects.

Limitations of the study: This study has several constraints that need to be acknowledged.

1. Small sample size: This study involved only 20 participants, which makes its findings less generalizable and reduces its statistical power to detect significant differences.
2. Short study duration: The treatment period was only 2 weeks, which may not be sufficient to observe significant changes in pain and functional ability in patients.
3. Limited outcome measures: The study only used the VAS and WOMAC scales to assess the outcomes of the patients. Additional objective measures, such as range of motion, muscle strength or gait analysis, could have provided a more comprehensive evaluation.

Recommendations for future Research: This study aimed to compare effectiveness of interferential therapy and the shortwave diathermy combined with exercise in patients with knee osteoarthritis grades 2 and 3. This study aimed to explore the effectiveness of the set of modalities in pain reduction and improvement of functional ability. This study also contributes to evidence- based physiotherapy by comparing which treatment approach provides better functional recovery and long-term symptom relief. However, the study remains constrained by its small sample size and short intervention duration.

To enhance generalizability and statistical power, a larger sample size and longer treatment duration (4-5weeks) should be considered in future studies. A follow-up assessment should be conducted to evaluate the sustainability of the intervention. Future investigations should focus on patients with different grades of knee osteoarthritis, allowing comparison of treatment outcomes across early, moderate and advanced stages of the condition to determine stage-specific effectiveness.

CONCLUSION

The research revealed that both groups experienced improvements in functional

ability when treated with Interferential therapy and shortwave diathermy combined with exercise for patients with grade 2 and 3 knee osteoarthritis. Although the group receiving IFT showed slightly more reduction in pain also, however the difference between the two groups was not statistically significant. Independent t-tests for between-group comparisons confirmed that the improvement difference was not statistically significant ($p > 0.05$). This indicates that while the IFT group had a marginally higher mean improvement, the difference was insufficient to declare one treatment is significantly superior to the other within the study's timeframe. Consequently, the study's results suggest that both Interferential Current Therapy and Shortwave Diathermy with exercise are effective physiotherapy treatments for alleviating pain and enhancing functional ability in patients with grade 2 and 3 knee osteoarthritis. The findings also underscore the critical role of therapeutic exercise as a core element of physiotherapy management for knee osteoarthritis, as it significantly alleviates symptoms and improves quality of life by boosting muscle strength, joint stability, range of motion, and overall functional performance.

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