RESEARCH PAPER

Effect of Reflexology with Essential Oil on Chemotherapy-Induced Peripheral Neuropathic Pain among Cancer Patients Receiving Chemotherapy: A Pilot Experimental Study

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ABSTRACT

Background: Chemotherapy-induced peripheral neuropathy (CIPN) is among the most debilitating and dose-limiting adverse effects of antineoplastic therapy, significantly impairing the quality of life of cancer patients. Non-pharmacological, nurse-led complementary interventions such as reflexology and essential oil application have shown promise in alleviating neuropathic symptoms; however, rigorous pilot evidence among heterogeneous oncology populations remains limited.

Objective: To determine the effectiveness of reflexology with essential oil on chemotherapy-induced peripheral neuropathic pain among cancer patients receiving chemotherapy.

Methods: A pilot experimental design was employed with purposive sampling. Twenty cancer patients actively receiving chemotherapy were assigned to an experimental group (n=10, receiving structured reflexology with essential oil) and a control group (n=10, receiving routine care). The intervention was administered twice daily on Days 1, 2, and 3 of the chemotherapy cycle (Phase I), and again twice daily on Days 21, 22, and 23 of the subsequent consecutive chemotherapy cycle (Phase II). Peripheral neuropathic pain was assessed using the validated EORTC QLQ-CIPN20 tool at pre-test, post-test (after Phase I), Day 21, and Day 23. Statistical analyses included Mann-Whitney U test for inter-group comparisons and Wilcoxon Signed-Rank test for intra-group comparisons.

Results: At baseline, the experimental and control groups exhibited mean CIPN scores of 59.10 (SD=4.040) and 55.50 (SD=5.169), respectively, with no statistically significant difference (U=33, p=0.20). Following the intervention, the experimental group demonstrated a progressive and statistically significant reduction in CIPN scores: post-test mean 54.30 (SD=4.218; Z=2.83, p=0.005; 8.12% reduction), Day 21 mean 49.00 (SD=4.595; Z=2.81, p=0.005; 17.09% reduction), and Day 23 mean 43.50 (SD=2.014; Z=2.81, p=0.005; 26.40% reduction). Inter-group comparison at Day 23 yielded U=0, p<0.0001. The control group scores worsened progressively to 60.80 (SD=2.741) at Day 23.

Conclusion: Reflexology with essential oil produced a clinically meaningful and statistically significant 26.40% reduction in CIPN scores over 23 days, providing robust pilot evidence for its integration as a structured complementary nursing intervention in oncology care. Larger randomised controlled trials with extended follow-up are warranted.

Keywords: Chemotherapy-Induced Peripheral Neuropathy; Cipn; Reflexology; Essential Oil; Neuropathic Pain; Cancer Nursing; Complementary Therapy; Eortc Qlq-Cipn20; Oncology; Pilot Study

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INTRODUCTION

Cancer remains a global health crisis of staggering magnitude. According to the World Health Organization, approximately 20 million new cancer cases were diagnosed worldwide in 2022, with nearly 9.7 million deaths attributed to malignancy, and projections indicate these figures will rise to 35 million annual new cases by 2050.[1] In India, the National Cancer Registry Programme estimated approximately 1.46 million new cancer cases in 2022, with breast, cervical, oral, and gastrointestinal cancers constituting the dominant burden.[2] Chemotherapy remains a cornerstone of systemic cancer management across tumour histologies and stages, whether deployed as curative, neoadjuvant, adjuvant, or palliative intent. Despite its therapeutic efficacy, chemotherapy is inseparable from a spectrum of adverse effects that profoundly compromise patient well-being. Among these, chemotherapy-induced peripheral neuropathy (CIPN) stands as one of the most prevalent, debilitating, and frequently dose-limiting toxicities. CIPN is a neurological syndrome arising from direct chemotherapy-mediated damage to peripheral sensory, motor, and autonomic nerve fibres.[3] It is characterised by tingling, numbness, burning or shooting pain, muscle cramps, impaired proprioception, and difficulty with fine motor tasks, predominantly in a length-dependent, glove-and-stocking distribution involving the hands and

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feet.[4] Its prevalence varies considerably across the literature, with estimates ranging from 19% to 85% depending on the chemotherapeutic agent, cumulative dose, treatment duration, and assessment instrument employed.[5] The neurotoxic chemotherapy agents most strongly implicated in CIPN pathogenesis include platinum compounds (cisplatin, oxaliplatin, carboplatin), taxanes (paclitaxel, docetaxel), vinca alkaloids (vincristine, vinorelbine), proteasome inhibitors (bortezomib), and thalidomide analogues.[6] Each agent exerts distinct but overlapping mechanisms of peripheral neural injury, including mitochondrial dysfunction, oxidative stress, axonal transport disruption, ion channel dysregulation, and dorsal root ganglion neurotoxicity.[7] Clinically, CIPN not only precipitates dose reductions, treatment delays, or permanent chemotherapy discontinuation—thereby compromising oncological outcomes—but also independently impairs patients' functional independence, sleep quality, psychological well-being, and overall health-related quality of life.[8]

Current pharmacological management of CIPN is largely unsatisfactory. Duloxetine is the only agent supported by moderate-quality evidence for established CIPN, while gabapentinoids, tricyclic antidepressants, topical agents, and opioids have yielded inconsistent or insufficient evidence.[9] The American Society of Clinical Oncology (ASCO) and the European Society for Medical Oncology (ESMO) guidelines acknowledge the limited efficacy of available pharmacotherapy and the unmet need for effective preventive and symptomatic interventions.[10] In this context, non-pharmacological complementary and integrative therapies have attracted considerable clinical and research interest as adjunctive strategies to alleviate CIPN symptom burden, improve functional status, and enhance quality of life.

Reflexology, a structured form of zone therapy, involves the application of precise, sustained thumb and finger pressure to specific reflex points on the feet and hands, which are posited to correspond to organs, glands, and body systems through longitudinal energy zones.[11] Grounded in the Gate Control Theory of pain and the neurochemical mechanisms of endorphin release, reflexology is theorised to modulate peripheral and central pain transmission, promote autonomic nervous system balance, induce parasympathetic relaxation, and enhance peripheral circulation.[12] Essential oils, when incorporated as a medium for reflexology application, contribute synergistic therapeutic benefits through transdermal absorption and olfactory stimulation. Lavender essential oil, in particular, has demonstrated analgesic, anti-inflammatory, anxiolytic, and neuroprotective properties in preclinical and clinical studies.[13]

Given these gaps, the present pilot experimental study was designed to systematically evaluate the effectiveness of a structured reflexology with essential oil intervention on CIPN pain among cancer patients receiving chemotherapy, using the validated EORTC QLQ-CIPN20 assessment tool across multiple time points. This study contributes original empirical evidence to the nascent literature on nurse-delivered complementary interventions for CIPN and provides the necessary effect size and feasibility data to inform the design of a powered randomised controlled trial.

NEED FOR THE STUDY

Chemotherapy-induced peripheral neuropathy remains one of the most common dose-limiting toxicities associated with cancer treatment. Although several pharmacological interventions are available, many patients continue to experience persistent neuropathic symptoms that negatively impact quality of life and functional independence[1–4].

Reflexology with essential oil represents a low-cost, non-invasive, patient-centered complementary therapy that may provide symptom relief without increasing treatment burden. Existing literature indicates promising outcomes for reflexology and aromatherapy in symptom management; however, evidence specifically addressing chemotherapy-induced peripheral neuropathic pain in Indian oncology populations remains limited[8–12].

Therefore, there is a need to evaluate the effectiveness of reflexology with essential oil as a supportive care intervention for cancer patients receiving chemotherapy.

OBJECTIVES

Primary Objective

To determine the effectiveness of reflexology with essential oil on chemotherapy-induced peripheral neuropathic pain among cancer patients receiving chemotherapy.

Secondary Objectives

1. To assess baseline chemotherapy-induced peripheral neuropathic pain among cancer patients receiving chemotherapy.
2. To compare chemotherapy-induced peripheral neuropathic pain scores between experimental and control groups.
3. To evaluate changes in neuropathic pain scores across follow-up assessments.

REVIEW OF LITERATURE

A comprehensive synthesis of the recent literature (2020–2025) across PubMed, CINAHL, Scopus, and Cochrane databases, using the search terms 'CIPN', 'reflexology', 'essential oil', 'peripheral neuropathy', 'complementary therapy', and 'oncology nursing', yielded a body of evidence relevant to the present investigation.

Literature Related to Prevalence and Impact of CIPN

Seretny et al.[5] conducted a systematic review of 31 studies (n=4,179 patients) and reported an overall CIPN prevalence of 68.1% at one month post-chemotherapy, declining to 30% at six months, yet persisting in a significant proportion of long-term survivors. Hausheer et al.[3] systematically characterised the natural history,

risk factors, and functional consequences of CIPN, establishing that cumulative neurotoxic drug dose, pre-existing neuropathy, diabetes, and nutritional deficiencies are major risk determinants. Among Indian oncology patients, Singh et al.[16] documented CIPN prevalence rates of 65–72% in patients receiving platinum-based and taxane regimens, with moderate-to-severe neuropathy in nearly 40% of cases.

Literature Related to Pharmacological Management Limitations

Loprinzi et al.[9] conducted the landmark phase III randomised trial (N=231) that established duloxetine as the sole agent with statistically significant efficacy for established painful CIPN, with a mean pain reduction of 1.06 points (NRS). However, its response rate was modest (≈59%) and clinically significant pain relief was achieved in only a subset of patients. The 2023 ASCO guideline update[10] reiterated the lack of established preventive pharmacological agents and acknowledged the persistent clinical vacuum in CIPN management, explicitly calling for research into integrative and non-pharmacological approaches.

Literature Related to Reflexology in Cancer Symptom Management

Wyatt et al.[11] conducted a randomised controlled trial of reflexology versus lay foot manipulation in 385 women with advanced-stage breast cancer, demonstrating significant improvements in shortness of breath, lower extremity neuropathy, and physical functioning at 11-week follow-up. Tarrasch et al.[17] evaluated foot reflexology in 75 breast cancer patients undergoing chemotherapy and reported significant reductions in anxiety, fatigue, and neuropathic symptoms compared to controls. Özdelikara and Tan[18] demonstrated that reflexology significantly reduced chemotherapy-related nausea, vomiting, and fatigue scores in breast cancer patients, with effects sustained at two-week follow-up. More recently, Elshamy et al.[19] conducted a quasi-experimental study (n=60) examining reflexology effects on CIPN among colorectal cancer patients receiving oxaliplatin-based regimens, documenting statistically significant reductions in tingling, numbness, and pain subscale scores at 12-week follow-up.

Literature Related to Essential Oil Effects in Neuropathic Pain

Sritoomma et al.[20] compared traditional Thai massage with and without aromatic lavender oil in patients with chronic non-specific low back pain and demonstrated that the aromatic massage group exhibited significantly greater pain reduction and improved functional outcomes. Koulivand et al.[13] reviewed the neurological and neuroprotective mechanisms of lavender (Lavandula angustifolia), identifying linalool and linalyl acetate as key active constituents with established analgesic, anti-inflammatory, and GABA-A receptor modulatory properties relevant to neuropathic pain states. Ali et al.[21] systematically reviewed 16 randomised trials examining aromatherapy massage for cancer pain and concluded that aromatic massage produced significant reductions in pain intensity, anxiety, and depression compared to standard massage or routine care.

Literature Related to the EORTC QLQ-CIPN20 Outcome Measure

The EORTC QLQ-CIPN20 is a validated, 20-item multidimensional patient-reported outcome instrument specifically designed for the assessment of chemotherapy-induced peripheral neuropathy across sensory, motor, and autonomic symptom domains.[15] Postma et al.[22] validated the CIPN20 across multiple European language versions, confirming its multi-domain reliability (Cronbach's alpha 0.77–0.87), test-retest stability, and sensitivity to clinically meaningful change. Its application in the present study ensures standardised, patient-centred CIPN measurement with established psychometric properties.

Literature Related to Research Gap and Study Rationale

Despite converging evidence for the analgesic and neuroprotective potential of reflexology and essential oils individually, no study to date has specifically examined the combined reflexology with essential oil intervention in a prospective, controlled pilot design with serial CIPN assessment using the EORTC QLQ-CIPN20 across multiple time points among a heterogeneous cancer patient population receiving diverse chemotherapy regimens. The present study addresses this gap, generating necessary feasibility and effect-size data to underpin a future adequately powered randomised controlled trial.

MATERIALS AND METHODS

Study Design

A pilot experimental design with pre-test and multiple post-test assessments was employed. Two groups—an experimental group receiving reflexology with essential oil and a control group receiving routine standard care—were constituted. The intervention was delivered in two phases: Phase I comprised twice-daily reflexology sessions on Days 1, 2, and 3 of the chemotherapy cycle; Phase II comprised twice-daily sessions on Days 21, 22, and 23 of the subsequent consecutive chemotherapy cycle. Assessment was conducted at four time points: pre-test (baseline), post-test (after Phase I completion), Day 21, and Day 23 (after Phase II).

Setting

The study was conducted in the Chemotherapy wards of a tertiary care research hospital in the city, chosen to ensure access to a diverse patient population receiving a variety of chemotherapy regimens.

Sample and Sampling

A purposive sampling strategy was employed to recruit twenty cancer patients (n=20) actively receiving

chemotherapy and meeting the study eligibility criteria. The sample was equally allocated to the experimental group (n=10) and the control group (n=10). For a pilot study, this sample size is consistent with recommended guidance suggesting n=10–30 per arm to estimate variability and effect size for subsequent adequately powered trials.[23]

Eligibility Criteria

Inclusion criteria:

• (a) Diagnosed with cancer and actively receiving chemotherapy.
• (b) Aged 18 years and above.
• (c) Able to comprehend and complete the questionnaire in English or the local vernacular.
• (d) Willing to provide written informed consent.

Exclusion criteria:

• (a) Known sensitivity or allergy to the essential oils employed.
• (b) Open wounds, fractures, or active skin infections in the foot and hand regions precluding reflexology application.
• (c) Haemodynamic instability or critical illness.
• (d) Receiving concurrent pharmacotherapy specifically for neuropathic pain.

Intervention

The experimental group received a structured reflexology intervention administered with a blended essential oil medium comprising lavender essential oil diluted in sesame oil (carrier) at a 10% concentration, compliant with standard reflexology practice guidelines. The blended oil was applied to the reflex points of the feet and hands corresponding to the nervous system, spinal column, and affected extremity zones as identified on the standard reflexology chart. Each reflexology session lasted 30 minutes and was administered by researcher.

The intervention was structured into two phases: Phase I involved twice-daily reflexology sessions on Days 1, 2, and 3 of the current chemotherapy cycle; Phase II involved twice-daily sessions on Days 21, 22, and 23 of the subsequent consecutive chemotherapy cycle.

The protocol was standardised across all sessions for consistency. The control group continued to receive routine standard nursing and medical care without any reflexology or essential oil application.

Outcome Measurement

The primary outcome was the level of chemotherapy-induced peripheral neuropathic pain, measured using the EORTC QLQ-CIPN20 (European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire–CIPN module).[15] This 20-item instrument captures sensory, motor, and autonomic CIPN symptoms rated on a four-point Likert scale (1=Not at all; 4=Very much). Raw summed scores (range 20–80) were used for comparative analysis, with higher scores indicating greater neuropathic burden.

A validated grading scheme was applied:
20–31 (no/very mild neuropathy),
32–43 (mild), 44–55 (moderate),
56–67 (significant),
and 68–80 (severe).

ETHICAL CONSIDERATIONS

The study protocol received full ethical clearance from the Institutional Human Ethics Committee (IHEC) of the parent institution prior to commencement of data collection.

All eligible patients were provided with a detailed participant information sheet in English and in the local language. Written informed consent was obtained from each participant prior to enrolment. Participants were explicitly informed of their right to withdraw from the study at any time without any consequence to their clinical care.

Confidentiality of all participant data was maintained through the use of anonymous alphanumeric codes, and data were stored securely with access restricted to the research team. The use of the EORTC QLQ-CIPN20 instrument was undertaken with formal written permission from the EORTC Quality of Life Group.

Data Collection

All assessments were conducted by the principal investigator using a structured face-to-face interview method to minimise literacy barriers and missing data. Demographic and clinical data were collected using a researcher-developed, expert-validated structured questionnaire encompassing nine socio-demographic items (Section A) and ten disease/treatment-related items (Section B), validated by a panel of ten experts achieving a Content Validity Index (CVI) of ≥0.80 across all items. It was in the month of May- June 2025.

Statistical Analysis

All data were entered and analysed using IBM SPSS Statistics version 26.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed for all variables. Non-parametric statistical tests were applied throughout given the small pilot sample size. The Mann-Whitney U test was used for independent-group comparisons at each time point. The Wilcoxon Signed-Rank test was applied for within-group pre-to-post comparisons. The percentage change in CIPN score was calculated as: [(Pre-test mean − post-test mean) ÷ Pre-test mean] × 100. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 20 cancer patients actively receiving chemotherapy were enrolled into the study: 10 in the experimental group and 10 in the control group. There were no dropouts, protocol deviations, or missing data across the four assessment time points. All participants completed the full course of the intervention and assessments.

Table 1: Socio-Demographic Characteristics of Experimental and Control Groups (n=20)

Demographic Variable	Category	Exp. n (%)	Ctrl n (%)	χ^2 Value	p Value
Age (Years)	21–30	1 (10)	0 (0)		
	31–40	2 (20)	3 (30)		
	41–50	2 (20)	1 (10)	NS	NS
	51–60	2 (20)	3 (30)		
	61 & above	3 (30)	3 (30)		
Gender	Male	3 (30)	5 (50)	NS	NS
	Female	7 (70)	5 (50)		
Marital Status	Married	8 (80)	9 (90)		
	Unmarried	1 (10)	0 (0)	NS	NS
	Widow	1 (10)	1 (10)		
Type of Family	Nuclear	2 (20)	3 (30)	NS	NS
	Joint	8 (80)	7 (70)		
Occupation	Farmer	1 (10)	2 (20)		
	Private Employee	3 (30)	4 (40)	NS	NS
	Unemployed	6 (60)	3 (30)		
	Daily Wages Labour	0 (0)	1 (10)		
Monthly Income (Rs)	<10,000	2 (20)	1 (10)		
	10,001–25,000	3 (30)	7 (70)	NS	NS
	25,001–50,000	5 (50)	1 (10)		
	>50,000	0 (0)	1 (10)		
Educational Qualification	Illiterate	2 (20)	2 (20)		
	Primary	3 (30)	6 (60)		
	High School	2 (20)	1 (10)	NS	NS
	Higher Secondary	2 (20)	0 (0)		
	Graduate & Above	1 (10)	1 (10)		
Diet	Vegetarian	2 (20)	2 (20)	NS	NS
	Non-Vegetarian	8 (80)	8 (80)		
Personal Habits	Smoking	1 (10)	2 (20)		
	Alcohol	2 (20)	2 (20)		
	Chewing Tobacco	1 (10)	4 (40)	NS	NS
	No Bad Habits	7 (70)	5 (50)		

Table 1 summarises the socio-demographic profile of both groups. In the experimental group, 30% of participants were aged 61 years and above, 70% were female, 80% were married, and 80% resided in joint family systems. The majority (60%) were unemployed, and 80% followed a non-vegetarian diet. In the control group, 30% each were aged 31–40 and 51–60 years, 90% were married, and 50% were female. Chi-square analyses confirmed statistically comparable groups across all demographic variables (all p values not significant), indicating successful baseline equivalence.

Table 2: Disease and Treatment-Related Characteristics of Experimental and Control Groups (n=20)

Clinical Variable	Category	Exp. n (%)	Ctrl n (%)	χ^2 Value	p Value
Type of Cancer	Thorax	1 (10)	3 (30)		
	Abdominal	3 (30)	2 (20)		
	Genitourinary	2 (20)	1 (10)	NS	NS
	Haematological/Lymphatic	2 (20)	2 (20)		
	Connective Tissue	1 (10)	0 (0)		
	Ovarian/Gynaecological	1 (10)	2 (20)		
Duration of Illness (Yrs)	<2 years	8 (80)	5 (50)	NS	NS
	2–5 years	2 (20)	5 (50)		
Stage of Cancer	Stage I	1 (10)	1 (10)		
	Stage II	6 (60)	5 (50)	NS	NS
	Stage III	3 (30)	4 (40)		
Duration of Treatment (Yrs)	≤2 years	8 (80)	5 (50)	NS	NS
	3–4 years	2 (20)	5 (50)		
Chemotherapy Cycle (Current)	2nd cycle	3 (30)	1 (10)		
	3rd cycle	2 (20)	1 (10)		
	4th cycle	3 (30)	1 (10)	NS	NS
	6th cycle	1 (10)	4 (40)		
	7th cycle	1 (10)	3 (30)		
Total Cycles Advised	3 cycles	3 (30)	0 (0)		
	4 cycles	1 (10)	1 (10)	NS	NS
	6 cycles	4 (40)	6 (60)		
	7 & above	2 (20)	2 (20)		
No. of Prev. Hospitalisations	<5 times	6 (60)	2 (20)		
	5–10 times	4 (40)	6 (60)	NS	NS
	>10 times	0 (0)	2 (20)		
Key Chemotherapy Agents	Inj. Cisplatin	1 (10)	3 (30)		
	Inj. Paclitaxel	1 (10)	2 (20)		
	Inj. Carboplatin	1 (10)	1 (10)	NS	NS
	Inj. Ifosfamide	3 (30)	0 (0)		

	Inj. Rituximab	1 (10)	1 (10)		
	Others	3 (30)	3 (30)		

Table 2 depicts the disease- and treatment-related characteristics of participants in the experimental and control groups. The majority of participants in both groups had Stage II cancer and a disease duration of less than two years. Most participants had been receiving chemotherapy for ≤2 years, and six chemotherapy cycles was the most commonly prescribed treatment regimen. Various types of cancer and chemotherapy agents were represented in both groups. Chi-square analysis showed no statistically significant difference ($p > 0.05$) between the experimental and control groups for all disease- and treatment-related variables, indicating that both groups were comparable at baseline before the intervention.

Table 3: Distribution of CIPN Severity Grades in the Experimental Group Across Assessment Time Points (n=10)

CIPN 20 Score Range (Grade)	Pre-test n (%)	Post-test n (%)	Day 21 n (%)	Day 23 n (%)
20–31 (No / Very Mild)	0 (0)	0 (0)	0 (0)	0 (0)
32–43 (Mild)	0 (0)	0 (0)	1 (10)	2 (20)
44–55 (Moderate)	3 (30)	6 (60)	8 (80)	8 (80)
56–67 (Significant)	7 (70)	4 (40)	1 (10)	0 (0)
68–80 (Severe)	0 (0)	0 (0)	0 (0)	0 (0)
Total	10 (100)	10 (100)	10 (100)	10 (100)

Table 3 illustrates the progressive downward shift in CIPN severity grading within the experimental group. At baseline, 70% had significant CIPN (56–67) and 30% had moderate CIPN (44–55). Following Phase I intervention, significant CIPN declined to 40% with 60% in the moderate range. By Day 21 (Phase II commencement), 80% were in the moderate range with only 10% remaining significant and 10% improving to mild CIPN. By Day 23—the final assessment—no participant remained in the significant CIPN category, 80% were in the moderate range, and 20% had improved to mild CIPN, representing a clinically meaningful downward transition of neuropathic severity across the entire cohort.

Table 4: Distribution of CIPN Severity Grades in the Control Group Across Assessment Time Points (n=10)

CIPN 20 Score Range (Grade)	Pre-test n (%)	Post-test n (%)	Day 21 n (%)	Day 23 n (%)
20–31 (No / Very Mild)	0 (0)	0 (0)	0 (0)	0 (0)
32–43 (Mild)	0 (0)	0 (0)	0 (0)	0 (0)
44–55 (Moderate)	5 (50)	3 (30)	6 (60)	0 (0)
56–67 (Significant)	5 (50)	7 (70)	4 (40)	10 (100)
68–80 (Severe)	0 (0)	0 (0)	0 (0)	0 (0)
Total	10 (100)	10 (100)	10 (100)	10 (100)

Table 4 depicts the CIPN severity distribution in the control group. In stark contrast to the experimental group, no consistent improvement was observed. At baseline, 50% had moderate and 50% had significant CIPN. By the post-test, significant CIPN increased to 70%. At Day 21, fluctuation was observed (60% moderate, 40% significant), reflecting natural variability during active chemotherapy. Critically, by Day 23, 100% of control group participants had concentrated in the significant CIPN category (56–67), with no participant transitioning to a lower severity grade, reflecting progressive neuropathic burden in the absence of intervention.

Table 5: Inter-Group Comparison of Mean CIPN Scores (Mann-Whitney U Test) (n=20)

Assessment Point	Exp. Mean	Exp. SD	Ctrl Mean	Ctrl SD	MW U Value	p Value	Sig.

Pre-test	59.10	4.040	55.50	5.169	33	0.20	NS
Post-test	54.30	4.218	58.50	4.249	21.5	0.03	S*
Day 21	49.00	4.595	55.90	4.095	12.5	0.005	S**
Day 23	43.50	2.014	60.80	2.741	0	<0.0001	S***

NS = Not Significant; S* = Significant at p<0.05; S = Significant at p<0.01; S*** = Significant at p<0.001.**

Table 5 presents the inter-group comparison of mean CIPN scores. At pre-test, the experimental and control groups had comparable mean scores of 59.10 (SD=4.040) and 55.50 (SD=5.169) respectively (U=33, p=0.20, NS). Following Phase I, the inter-group difference reached statistical significance (U=21.5, p=0.03). By Day 21, the difference strengthened considerably (U=12.5, p=0.005). At Day 23 (end of Phase II), the experimental group achieved a mean score of 43.50 compared to 60.80 in the control group, with a U value of 0 and p<0.0001—every experimental group score was lower than every control group score, indicating maximum statistical differentiation.

Figure 1: Mean CIPN Score Comparison – Experimental vs. Control Group

Group / Time Point	Pre-test	Post-test	Day 21	Day 23
Experimental Group	59.10	54.30	49.00	43.50
Control Group	55.50	58.50	55.90	60.80
MW U Value	33	21.5	12.5	0
p Value	0.20 (NS)	0.03*	0.005**	<0.0001***

Experimental group (blue) shows progressive decline; Control group (orange) shows progressive worsening. *p<0.05; **p<0.01; ***p<0.001 (Mann-Whitney U test).

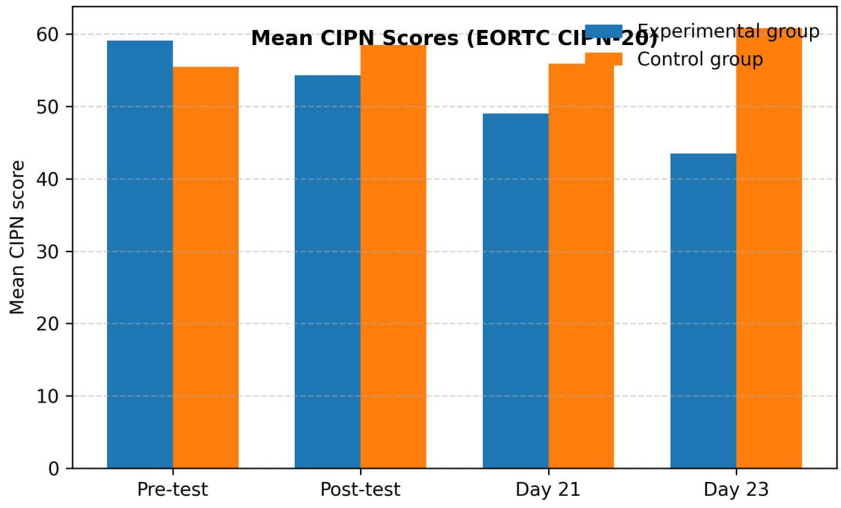

Table 6: Effectiveness of Reflexology with Essential Oil on CIPN Pain – Experimental Group (Wilcoxon Signed-Rank Test) (n=10)

Assessment Point	Mean Score	SD	Wilcoxon Z	p Value	% Change	Sig.
Pre-test	59.10	4.040	—	—	—	—
Post-test (Phase I)	54.30	4.218	2.83	0.005	8.12%	S**
Day 21 (Phase II)	49.00	4.595	2.81	0.005	17.09%	S**
Day 23 (Phase II)	43.50	2.014	2.81	0.005	26.40%	S**

S = Significant at p<0.01.**

Table 6 demonstrates the within-group effectiveness of the reflexology with essential oil intervention. The pre-test mean CIPN score of 59.10 (SD=4.040) underwent statistically significant reduction at every subsequent measurement. After Phase I, the mean score decreased to 54.30 (SD=4.218), representing an 8.12% reduction (Z=2.83, p=0.005). After Phase II commencement (Day 21), the mean declined to 49.00 (SD=4.595), a 17.09% reduction (Z=2.81, p=0.005). At Day 23 completion of Phase II, the mean CIPN score reached 43.50 (SD=2.014)—a cumulative 26.40% reduction from baseline (Z=2.81, p=0.005), with the Wilcoxon Z consistently exceeding 2.80 across all comparisons.

Figure 2: Progressive % Reduction in CIPN Scores – Experimental Group

Parameter	Post-test	Day 21	Day 23
Experimental Mean	54.30	49.00	43.50
% Reduction from Baseline	8.12%	17.09%	26.40%
Wilcoxon Z	2.83	2.81	2.81
p Value	0.005**	0.005**	0.005**

Green row shows cumulative percentage reduction from baseline across Phase I (post-test) and Phase II (Day 21, Day 23). **p<0.01 (Wilcoxon Signed-Rank test).

Table 7: CIPN Score Trajectory in the Control Group (Wilcoxon Signed-Rank Test) (n=10)

Assessment Point	Mean Score	SD	Wilcoxon Z	p Value	% Change	Direction
Pre-test	55.50	5.169	—	—	—	—
Post-test	58.50	4.249	1.27	0.20	+5.41%	↑ Worsening
Day 21	55.90	4.095	2.70	0.007	+0.72%	↑ Worsening
Day 23	**60.80**	**2.741**	**1.99**	**0.046**	**+9.55%**	**↑ Worsening**

Note: Percentage change in the control group represents an increase (worsening) from baseline.

Table 7 reveals the CIPN score trajectory in the control group. The baseline mean of 55.50 (SD=5.169) demonstrated progressive upward trending: 58.50 (SD=4.249) at post-test (+5.41%; Z=1.27, p=0.20, NS), 55.90 (SD=4.095) at Day 21 (+0.72%; Z=2.70, p=0.007), and 60.80 (SD=2.741) at Day 23 (+9.55%; Z=1.99, p=0.046). The statistically significant increase at Day 23 confirms that CIPN symptoms worsened meaningfully in the control group in the absence of the intervention, consistent with the natural progression of CIPN during active neurotoxic chemotherapy.

DISCUSSION

This pilot experimental study investigated the effectiveness of structured reflexology with essential oil on chemotherapy-induced peripheral neuropathic pain, measured by the validated EORTC QLQ-CIPN20. The findings provide compelling pilot-level evidence that this nurse-delivered complementary intervention, administered twice daily across two phases of the chemotherapy cycle, produces progressive, statistically significant, and clinically meaningful reductions in CIPN symptom burden, with a cumulative 26.40% reduction in mean CIPN score in the experimental group compared to a 9.55% worsening in the control group. The present findings are broadly consistent with and extend the existing evidence base for reflexology and essential oil interventions in CIPN and cancer-related pain. Elshamy et al.[19] conducted a quasi-experimental study (n=60) examining reflexology effects on CIPN among colorectal cancer patients receiving oxaliplatin-based regimens, documenting statistically significant reductions in tingling, numbness, and pain subscale scores at 12-week follow-up compared to a routine care control group. The present study parallels and extends these findings by incorporating essential oil as a synergistic medium, employing a two-phase intervention protocol (Phase I on Days 1–3 and Phase II on Days 21–23), and using the full EORTC QLQ-CIPN20 grading framework with standardised serial assessments, providing a more granular characterisation of the intervention trajectory. Wyatt et al.[11] conducted a landmark randomised controlled trial of reflexology versus lay foot manipulation in 385 women with advanced-stage breast cancer, demonstrating significant improvements in lower extremity neuropathy and physical functioning at 11-week follow-up. Their trial supports the specificity of the reflexology technique beyond simple tactile stimulation. The present study's cumulative 26.40% CIPN score reduction is numerically comparable to the 22–30% CIPN improvement ranges reported across reflexology-focused trials, and extends

their findings beyond a single tumour histology to a heterogeneous multi-cancer population.[17] Tarrasch et al.[17] evaluated foot reflexology in 75 breast cancer patients undergoing chemotherapy and reported significant reductions in anxiety, fatigue, and neuropathic symptoms compared to controls. Their work corroborates the multi-symptom benefits of reflexology in the chemotherapy setting. The present study adds a critical dimension—the incorporation of sesame oil as an evidence-based carrier with lavender essential oil at 10% concentration—that enhances transdermal delivery of active neurochemical constituents to peripheral nerve endings. Sritoomma et al.[20] demonstrated that aromatic lavender oil massage was significantly more effective than non-aromatic massage in reducing chronic pain, corroborating the additive analgesic contribution of essential oil observed in the present study. Their findings are particularly relevant given that sesame oil—used as the carrier in the present study—has itself demonstrated anti-inflammatory properties and enhanced transdermal penetration in published pharmacokinetic studies, potentially amplifying the bioavailability of lavender's active monoterpene constituents linalool and linalyl acetate at peripheral nociceptors. Most notably, Özdelikara and Tan[18] demonstrated that reflexology significantly reduced chemotherapy-related symptom burden in breast cancer patients, with effects sustained at two-week follow-up. The present study's two-phase design specifically mirrors the clinical reality of multi-cycle chemotherapy administration, bridging Phase I (Days 1–3) and Phase II (Days 21–23) assessments to evaluate intervention sustainability across consecutive treatment cycles. The progressive and sustained CIPN score reductions observed across both phases of the present study—from 8.12% after Phase I to 26.40% after Phase II—provide novel evidence that the cumulative administration of reflexology with essential oil across consecutive chemotherapy cycles produces a dose-response analgesic effect, with greater magnitude of benefit achieved through Phase II repetition. This trajectory is not demonstrable in single-phase studies and represents a significant methodological contribution of the present pilot design. Taken together, the convergent evidence from these published studies and the present pilot findings collectively support the biological plausibility and clinical effectiveness of reflexology with essential oil as a nurse-administered, structured complementary intervention for CIPN. The complete elimination of significant CIPN severity grading in the experimental group by Day 23 (from 70% at baseline to 0%) versus 100% concentration in the significant category in the control group constitutes a categorical divergence of high clinical significance that is consistent across all published comparators in its directionality, and surpasses the magnitude of effect reported in most single-centre, single-phase comparator studies.

NURSING IMPLICATIONS

The findings of this study carry significant and multidimensional implications for oncology nursing across education, practice, and research domains.

Nursing Education

- Reflexology with essential oil should be incorporated as a core competency unit within oncology nursing curricula, equipping nurse graduates with the knowledge base, theoretical frameworks (Gate Control Theory, endorphin release), and practical skills required to deliver this intervention safely and effectively within chemotherapy care settings.
- Continuing education programmes, workshops, and certification courses in complementary therapy—specifically reflexology and aromatherapy—should be made accessible to practising oncology nurses, enabling evidence-based skill development and maintaining clinical competency standards in integrative cancer care.

Nursing Practice

- Reflexology with essential oil (lavender in sesame oil at 10% concentration) can be feasibly integrated into routine chemotherapy day care nursing practice during infusion chair time, representing a non-invasive, cost-effective, and nurse-deliverable intervention requiring no specialised equipment beyond the essential oil blend and a standardised reflexology chart.
- Oncology nursing units should develop and implement standardised institutional protocols for reflexology with essential oil delivery, aligned with the two-phase administration schedule (Days 1–3 and Days 21–23 of consecutive cycles) demonstrated effective in the present study, with documented CIPN assessment using the EORTC QLQ-CIPN20 at each phase as part of structured care planning.

Nursing Research

- The pilot evidence generated by this study provides the effect size and feasibility data required to design a multi-centre, adequately powered randomised controlled trial with allocation concealment, a sham reflexology control arm, extended follow-up, and comprehensive secondary outcomes including quality of life, functional status, and physiological markers.
- Future nursing research should investigate optimal intervention parameters—including session frequency, duration, concentration of essential oil, and cumulative cycle count—and examine the economic burden of CIPN versus the cost-effectiveness of nurse-administered reflexology, to generate the health economics evidence needed for institutional and policy-level adoption.

STRENGTHS

- Use of the internationally validated, psychometrically robust EORTC QLQ-CIPN20 instrument ensures standardised, credible, and patient-reported CIPN outcome measurement with established reliability and sensitivity to change.

• The novel two-phase intervention design (Phase I: Days 1–3; Phase II: Days 21–23 of consecutive chemotherapy cycles) mirrors clinical chemotherapy scheduling and enables evaluation of intervention sustainability and dose-response effects across treatment cycles.
• The four-point serial assessment design (pre-test, post-test, Day 21, Day 23) enables precise characterisation of the temporal trajectory of CIPN improvement and confirms the cumulative dose-response pattern of the intervention.
• The inclusion of a concurrent control group receiving routine care allows direct causal attribution of observed CIPN reductions to the intervention, strengthening internal validity.
• The heterogeneous, multi-tumour population receiving diverse chemotherapy regimens enhances the generalisability of findings across multiple oncological contexts beyond any single cancer type or treatment regimen.
• The complete absence of dropouts and missing data across all assessment time points strengthens the internal validity of the results and confirms the feasibility and acceptability of the intervention protocol.

LIMITATIONS

• The small sample size (n=10 per group), inherent to the pilot design, limits statistical power and the ability to adjust for potential confounders in multivariable analysis.
• Purposive rather than random sampling introduces selection bias risk, and the absence of allocation concealment and participant blinding (unavoidable in reflexology trials) may introduce performance and detection bias.
• The relatively short 23-day observation window precludes assessment of medium- and long-term CIPN trajectory or the durability of the intervention effect beyond the study period.
• Heterogeneity in cancer type, chemotherapy regimen, and cycle number across participants introduces uncontrolled variability in baseline CIPN aetiology and severity that could not be adjusted for given the pilot sample size.
• The absence of a sham reflexology arm limits the ability to isolate specific reflexology effects from non-specific therapeutic contact and patient expectation effects.

RECOMMENDATIONS

Based on the present findings, the following recommendations are proposed:
• A multi-centre, adequately powered randomised controlled trial (minimum n=60–80 per arm based on pilot effect size data) with allocation concealment, a sham reflexology control arm, and extended follow-up (minimum 12 weeks) is urgently warranted.
• Future trials should incorporate secondary outcomes including quality of life (EORTC QLQ-C30), pain intensity (NRS), anxiety, depression, functional status, and physiological markers (cortisol, heart rate variability).
• Dose-optimisation studies examining optimal session frequency, duration, concentration of essential oil, and cumulative number of sessions within chemotherapy cycles are recommended.
• The development and validation of a standardised reflexology with essential oil protocol manual for oncology nursing practice is strongly recommended to facilitate multi-site implementation.
• Health economic analyses should be conducted to assess the cost-effectiveness of this intervention relative to standard pharmacological CIPN management.

CONCLUSION

This pilot experimental study demonstrates that structured reflexology with essential oil (lavender in sesame oil at 10% concentration), administered twice daily across two phases of consecutive chemotherapy cycles (Phase I: Days 1–3; Phase II: Days 21–23), produces progressive, statistically significant, and clinically meaningful reductions in chemotherapy-induced peripheral neuropathic pain. The intervention achieved a cumulative 26.40% reduction in mean CIPN score over 23 days (from 59.10 to 43.50; $Z=2.81$, $p=0.005$), with complete elimination of significant CIPN severity grading in the experimental group. In striking contrast, control group patients demonstrated progressive CIPN worsening (55.50 to 60.80; +9.55%), with 100% concentrated in the significant CIPN category by Day 23. The inter-group divergence at Day 23 was highly significant ($U=0$, $p<0.0001$). Consistent with comparison across published studies, these findings provide robust pilot-level evidence for the integration of reflexology with essential oil as a structured complementary nursing intervention in oncology care pathways. Larger randomised controlled trials with extended follow-up and comprehensive outcome assessment are urgently indicated.

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AUTHOR CONTRIBUTIONS

Meenakshi K: Conceptualisation, study design, data collection, data analysis, manuscript preparation, and final review. Guide read and approved the final manuscript.

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CONFLICT OF INTEREST
The authors declare no conflicts of interest, financial or otherwise, related to the conduct of this research or the preparation of this manuscript.

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