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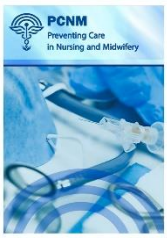

Original Article

Effect of Foot Reflexology Massage on Pain and Fatigue after Lumbar Spine Surgery: A Randomized Controlled Trial

Seyedeh Esmat Hosseini [1], Maryam Amirpour[2], Mostafa Javadi [2*]

[1] Department of Medical Surgical Nursing, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran
[2] Department of Nursing, School of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

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[*]Corresponding author:
Mostafa Javadi
Department of Nursing, School of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
Email: javadinurse@gmail.com

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Abstract

Background: Pain and fatigue control after spinal surgery is a significant concern. Foot reflexology massage has a beneficial effects in reducing pain and fatigue in patients.
Objectives: This study aimed to determine the effect of foot reflexology massage on postoperative pain and fatigue after lumbar spine surgery.
Methods: This randomized, parallel-group controlled trial was conducted among 68 patients undergoing lumbar spine surgery at Ayatollah Beheshti Hospital in Yasuj, Iran. Participants were randomly allocated to either the experimental or control group using a computer-generated randomization sequence. The experimental group received a standardized 30-minute foot reflexology massage session at least 4 hours after analgesic administration, while the control group received routine postoperative care without therapeutic massage. Data were collected using a demographic information form and a Visual Analog Scale (VAS). Pain, fatigue, and hemodynamic indicators were measured in both groups at 30, 60, 90 minutes, and 24 hours post intervention. Data were analyzed using repeated-measures analysis of variance (ANOVA) in SPSS, version 20.
Results: The results indicated that the experimental group had lower pain and fatigue scores compared with the control group ($p < 0.001$). Significant group, time, and group-by-time interaction effects were observed ($p < 0.01$, $\eta^2 = 0.07–0.15$), while no significant differences were found at 24 hours.
Conclusion: Foot reflexology massage may help reduce pain and fatigue in the early postoperative period after spinal surgery, but its effect does not appear to persist at 24 hours.

Implications for Nursing and Midwifery Preventive Care

- Foot reflexology can be used as a preventive nursing approach to help reduce pain and fatigue after spinal surgery.
- Non-pharmacological methods support preventive care and improve nursing care quality through early symptom management.

Introduction

Low back pain is the second most prevalent cause of chronic pain after headache, with up to 50–80% of adults experiencing it in their lifetime, sometimes resulting in surgery [1]. Spinal surgery is a major surgical procedure and is one of the most common types that leads to severe, long-term postoperative pain [2]. While most spinal surgeries are performed to relieve pain, the procedure itself is very painful. It is undesirable for many, which leads to patient dissatisfaction with the results of the surgery, and postoperative pain is often not adequately treated [3]. Pain and fatigue following surgery are common experiences for millions of people worldwide. Since the goal of medicine is to establish and maintain health, reducing suffering, effective pain relief, and fatigue reduction after surgery are crucial [4].

Although drug therapy is the most effective tool for nurses to reduce pain and fatigue in patients, the side effects of drugs necessitate the use of non-pharmacological methods to reduce pain and fatigue in addition to medication [5]. Non-pharmacological methods are becoming more and more popular, and it is estimated that one in three people will use these treatments during their lifetime for common diseases such as back problems, headaches, anxiety, and depression [6]. Most of these interventions are inexpensive and easy to perform, and are often without known side effects or risks, and are used alone or in combination with other methods. One non-pharmacological method is foot massage therapy, which is performed through reflexology [7]. Today, massage therapy is one of the most widespread forms of complementary therapies in the United States [8]. These methods are among several care methods that nurses use to reduce pain and help patients feel better. Complementary methods such as massage and muscle relaxation provide comfort and a sense of calm, correct physical dysfunction, change physiological responses, and improve vital signs [9]. Foot reflexology massage has a comprehensive function, meaning that in addition to reducing physical problems (pain, fatigue, physiological indicators, etc.), it also affects the psychological dimension (sleep, anxiety, depression, stress, etc.) of humans. As a result, it reduces the physical, psychological, and social dimensions of pain and fatigue [10].

The Gate Control Theory provides the physiological basis for massage's efficacy. By applying controlled tactile stimulation, massage generates sensory signals that compete with and inhibit pain transmissions to the brain. This process shifts the focus from nociceptive stimuli to positive physical contact, while simultaneously triggering the release of neurotransmitters like endorphins and serotonin to modulate the patient's response to surgical stress [11].

Various studies have shown the positive effects of reflexology in various conditions. In a systematic review of 44 studies on the effects of reflexology on sleep, fatigue, and pain, Lee describes reflexology as a nursing intervention and a method for improving sleep and fatigue, and considers its effects on pain and other variables to require further study [12]. The effectiveness of foot reflexology massage has been shown to reduce pain after cesarean section and appendectomy [13, 14], and reduce pain intensity and fatigue after coronary artery bypass graft surgery [15]. However, specific data regarding the application of reflexology in the neurosurgery recovery phase remains limited.

By incorporating reflexology into postoperative care, nurses can proactively address discomfort, thus preventing complications such as immobility, deep vein thrombosis, and muscle atrophy, which are linked with prolonged bed rest and unmanaged pain [16].

Furthermore, reflexology promotes relaxation, reduces anxiety, and enhances overall well-being, which are vital components of holistic preventive care [17]. Such interventions can be integrated into nursing protocols to support early mobilization and functional recovery, thereby reducing hospitalization duration and healthcare costs. Importantly, reflexology is non-invasive, cost-effective, and easy to administer, making it accessible as a preventive strategy within various healthcare settings [18].

Considering the importance of reducing complications after spinal surgery and knowing that pharmacological methods of pain relief, in addition to being costly, have numerous complications, the

use of non-pharmacological methods of pain control is recommended.

Objectives

Considering that patients complain of surgical pain and fatigue due to discomfort after spinal surgery, this study was designed to investigate the effect of foot reflexology massage on pain and fatigue after lumbar spine surgery.

Methods

Study Design

This study was a randomized controlled trial with a parallel-group pretest–posttest design conducted in Yasuj Province, Iran between September 2017 and November 2019.

Participants and Sampling

The target population consisted of patients referred to Shahid Beheshti Hospital, affiliated with Yasuj University of Medical Sciences, Yasuj, Iran, for lumbar spine surgery due to intervertebral disc herniation or spinal canal stenosis. Participants were recruited based on a set of eligibility criteria, which included a history of chronic low back pain lasting at least three months prior to surgery, full consciousness throughout the study period, an age range of 35 to 60 years, a diagnosis of moderate lumbar spinal stenosis confirmed by MRI by a physician, and a Body Mass Index (BMI) between 16.5 and 30 kg/m². Exclusion criteria comprised massage intolerance, lower extremity numbness or paralysis, peripheral vascular diseases, substance abuse, use of patient-controlled analgesia (PCA) pumps, as well as cases involving intervertebral disc rupture and severe spinal stenosis.

To maintain cultural sensitivity and patient comfort, foot reflexology was performed by gender-matched certified therapists (female for female participants and male for male participants).

Both therapists held nursing degrees with equivalent clinical experience and received certification from the same massage therapy center. To minimize confounding variables, the same surgeon performed all surgical procedures, and participants received standardized analgesic protocols at equivalent doses. Participants were recruited through convenience sampling and then randomly assigned to either the experimental or control Group using a computer-generated randomization sequence. This sequence was produced using the RANDBETWEEN function in Microsoft Excel to ensure a stochastic and unbiased distribution of subjects across the study arms [19].

The sample size was calculated based on a two-group comparison of means using effect size estimates from a previous randomized clinical trial investigating foot reflexology on fatigue outcomes [20], with a significance level of 0.05 and a power of 90%. This resulted in 31 participants per Group. To account for a potential 10% attrition rate, the final sample size was increased to 34 participants per Group, resulting in a total of 68 patients.

Intervention

Patients were maintained on complete bed rest (CBR) for 6 to 8 hours postoperatively. Depending on ward routines and patient conditions, the intervention was performed the following morning between 9:00 and 11:00 AM. Each participant in the experimental Group received a detailed explanation of the procedure and was reassured that the massage would not interfere with their standard care. To avoid confounding the effects of the intervention with peak narcotic activity, the massage was administered at least 4 hours after analgesic medication, coinciding with the decline in their plasma concentration or half-life [20].

Before the intervention, the researcher sanitized their hands with warm water and applied refined extra-virgin olive oil (Samin Brand) to ensure adequate warmth and skin lubrication. Participants were placed in a supine position and instructed to remain quiet unless communication was necessary. During the session, each leg was supported and slightly elevated with a pillow, which was removed upon completion. The reflexology was performed using circular thumb and finger pressure on specific pedal reflex zones.

The procedure began with a 5-minute relaxation phase, including effleurage, warm-up frictions, diaphragm line release, and the solar plexus technique [21]. This was followed by 10 minutes of targeted massage on the pituitary, solar plexus, and spinal reflex points. The total duration of the intervention was 30 minutes (15 minutes per foot). For the control group, the feet were oiled at 15-minute intervals without applying any therapeutic pressure, ensuring an equivalent volume of olive oil was used. In both groups, pain intensity and fatigue were assessed by the same blinded evaluator at baseline (pre-intervention) and subsequently at 30, 60, and 90 minutes, and 24 hours post-intervention.

Instruments and Measures (Validity & Reliability)

To collect data, a demographic form and visual analog scale (VAS) were used. The demographic form included age, gender, marital status, level of education, hospitalization history, and surgical history.

A visual analog scale (VAS) was used to measure patients' pain and fatigue, which was rated from 0 (absence of pain and fatigue symptoms) to 10 (maximum severity of symptoms) [21].

The patient was asked to select the corresponding point on the line that indicated the severity of his pain and fatigue (separately). For this purpose, the scale was shown to the patient before the intervention and the necessary explanation was given to him. The validity and reliability of this tool have been assessed in previous studies, and Cronbach's alpha coefficients have been reported to be 0.86 (95%CI 0.84–0.88) [22].

To measure the reliability of the questionnaire, it was administered to 20 patients, and then Cronbach's alpha coefficient was calculated; this number was then excluded from the main sample. In this study, the reliability of the questionnaire was confirmed for pain with Cronbach's alpha of 0.89 and fatigue with 0.91.

Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). The normality of all continuous variables at each measurement point was assessed using the Shapiro–Wilk test, confirming that the assumption of normal distribution was met. Accordingly, parametric tests were applied.

Baseline characteristics were compared between the intervention and control groups using the independent t-test for continuous variables and the chi-square or Fisher's exact test for categorical variables. Repeated measures analysis of variance (RM ANOVA) was employed to examine changes in pain and fatigue over time (before the intervention, immediately after, 60 minutes, 90 minutes, and 24 hours) and to assess differences between the two study groups across these time points. Mauchly's test was used to evaluate the assumption of sphericity; when violated, the Greenhouse–Geisser correction was applied. Pairwise comparisons were conducted using the Bonferroni-adjusted post hoc test.

All analyses were performed using a per protocol approach, as all participants completed the study without dropout.

Effect sizes for RM ANOVA were reported using partial eta squared (η^2). A significance level of 0.05 was adopted for all statistical tests.

Result

Of the 95 patients assessed, 68 met the inclusion criteria and were enrolled in the study [Figure 1]. Of these, 34 were randomly assigned to the experimental Group with a mean (SD) age of 45.67 (11.87) years, and 34 to the control group with a mean age of 45.08 (11.75) years. All participants completed the study, and no attrition occurred. The two groups were comparable at baseline, with no statistically significant differences in demographic characteristics [Table 1].

Overall, pain levels changed significantly over time in both groups. However, the pattern of change differed between the two groups.

There was a significant main effect of time ($p < 0.001$), indicating that pain scores varied across all measurement points. A significant group effect was also observed ($p = 0.005$), showing that overall pain was lower in the experimental Group compared with the control group.

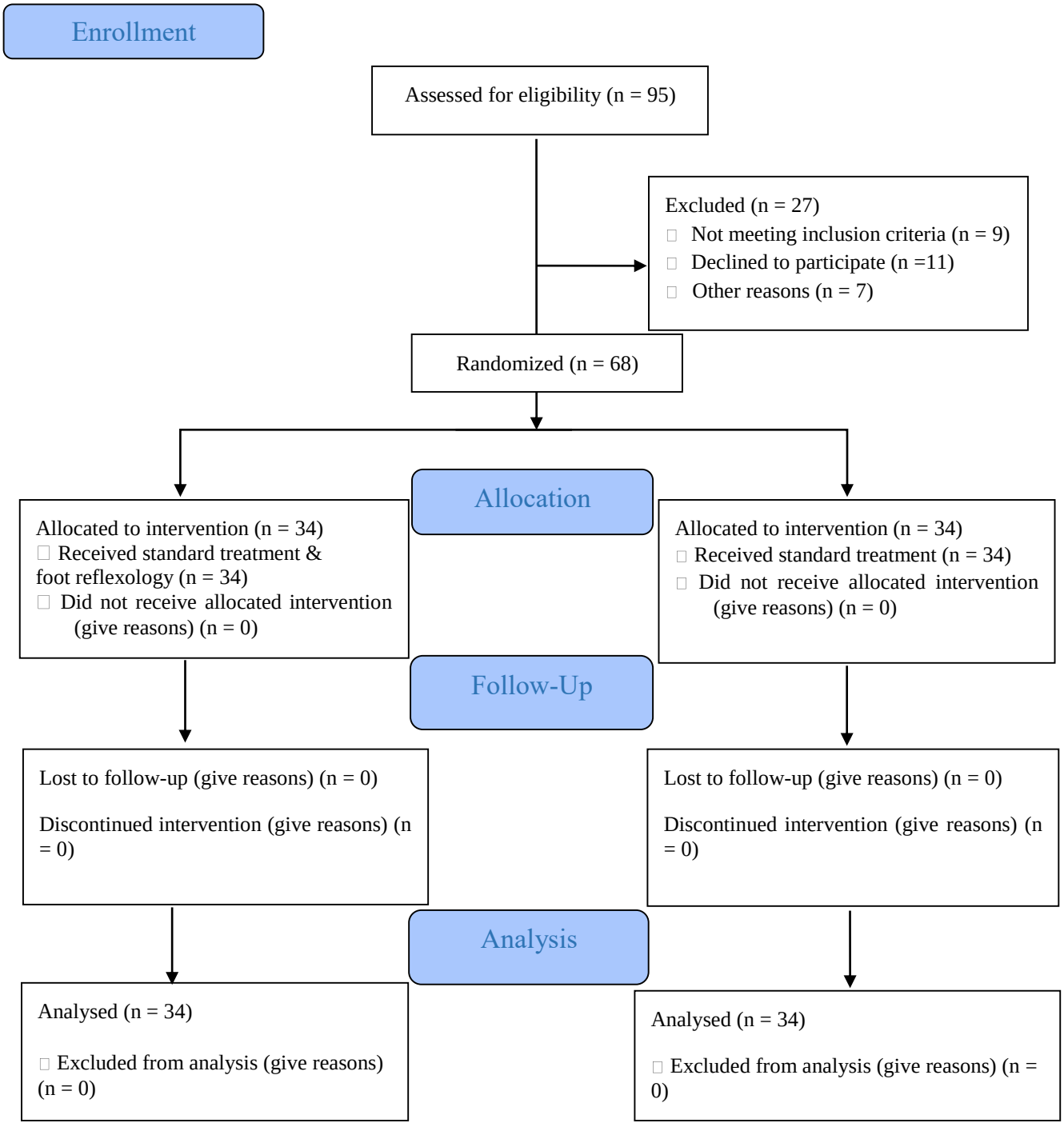

Figure 1. CONSORT Flow Diagram

Table 1 . Demographic Characteristics of Participants in the Experimental and Control Groups

Variable	Category	Experimental Group n (%)	Control Group n (%)	*p*
Gender	Female	15 (44.1)	15 (44.1)	1.000
	Male	19 (55.9)	19 (55.9)	
Education level	Primary school and less	14 (41.2)	16 (47.1)	0.950
	Middle school	3 (8.8)	3 (8.8)	
	Diploma	11 (32.4)	10 (29.4)	
	Academic degree	6 (17.6)	5 (14.7)	
Marital status	Single	4 (11.8)	3 (8.8)	0.690
	Married	30 (88.2)	31 (91.2)	
Hospitalization history	Yes	24 (70.6)	23 (67.6)	0.790
	No	10 (29.4)	11 (32.4)	
Surgical history	Yes	25 (73.5)	20 (58.8)	0.305
	No	9 (26.5)	14 (41.2)	

Note. Values are presented as frequency (percentage). Statistical tests: chi-square or Fisher's exact test.

Importantly, the time × group interaction was statistically significant ($p < 0.001$), suggesting that the trajectory of pain reduction over time differed between the two groups.

Pairwise comparisons revealed no baseline difference between the groups ($p = 0.78$). After the intervention, pain was significantly lower in the experimental Group at 30, 60, and 90 minutes; however, this difference was no longer statistically significant at 24 hours post-intervention ($p = 0.21$) [Table 2].

A similar pattern was observed for fatigue. Fatigue scores changed significantly over time in both groups ($p = 0.003$), and a significant group effect indicated lower overall fatigue in the experimental Group compared with the control group ($p = 0.020$). The time × group interaction was also significant ($p = 0.004$), indicating that fatigue changes over time differed between the two groups.

Post hoc comparisons showed no baseline difference between groups ($p = 0.401$). After the intervention, fatigue was significantly lower in the experimental Group immediately after, as well as at 60 and 90 minutes. However, no significant difference was observed at 24-hour post-intervention ($p = 0.162$) [Table 3].

Table 2. Comparison of Pain in the Two Intervention and Control Groups at Different Times of the Study

Time	Study Groups			Repeated Measures Analysis of Variance		
Control	Control	Experimental	Multiple comparisons: Bonferroni	Main effect of Group	Main effect of Time (GG)	Time by Group interaction (GG)
Before intervention	5.82 (1.38)	5.88 (0.95)	0.78 (ns)			
After intervention	5.29 (1.56)	3.94 (1.41)	< 0.001			
60 minutes	5.53 (1.72)	4.26 (1.48)	0.002	F (1, 66) = 8.28 $p = 0.005$ $\eta^2 = 0.111$	F (2.855, 188.447) = 26.02 $p < 0.001$ $\eta^2 = 0.283$	F (2.855, 188.447) = 11.93 $p < 0.001$ $\eta^2 = 0.153$
90 minutes	5.44 (1.56)	4.15 (1.42)	< 0.001			
24 hours	4.91 (0.96)	4.65 (1.10)	0.21 (ns)			

Note. Values are presented as mean (standard deviation); ns = not significant; GG: Greenhouse-Geisser.

Table 3. Comparison of Fatigue in the Two Intervention and Control Groups at Different Times of the Study

Time	Study Groups			Repeated Measures Analysis of Variance		
	Control	Experimental	Multiple comparisons: Bonferroni	Main effect of Group	Main effect of Time (GG)	Time by Group interaction (GG)
Before intervention	4.53 (1.81)	4.21 (1.30)	0.401(ns)			
After intervention	4.35 (1.72)	3.35 (1.32)	0.009	F (1, 66) = 5.66 p = 0.020 Partial η^2 = 0.079	F (2.47, 163.03) = 5.49 p = 0.003 Partial η^2 = 0.077	F (2.47, 163.03) = 5.05 p = 0.004 Partial η^2 = 0.071
60 minutes	4.62 (1.60)	3.32 (1.27)	0.001			
90 minutes	4.41 (1.35)	3.71 (1.36)	0.035			
24 hours	4.47 (1.24)	4.03 (1.51)	0.162 (ns)			

Note. Values are presented as mean (standard deviation); ns = not significant; GG: Greenhouse-Geisser.

Discussion

In this study, the main objective was to investigate the effects of massage on pain reduction and fatigue in patients after spinal surgery. The results indicate that massage is an effective method for rapid pain relief after surgery, likely related to physiological mechanisms such as increased secretion of endorphins and decreased secretion of stress hormones [23]. Some studies in recent years have also shown that post-surgical massage can reduce the severity of patients' pain and have reported positive effects in reducing pain [24]. In addition, studies by Wang et al. and Mokhtari Nouri et al. have also confirmed the positive effects of reflexology massage in reducing post-surgical pain and the trend of decreasing pain intensity. These results are consistent with the findings of the present study, emphasizing the positive role of massage in reducing pain [25, 26].

The present study demonstrated a significant time-by-group interaction, indicating that foot reflexology massage produces a time-dependent reduction in pain levels, with the most pronounced effects observed at 30-, 60- and 90-minutes post-intervention.

A systematic review of 13 randomized controlled trials with 1189 pregnant women was conducted. The results showed that, compared with the control group, foot reflexology massage reduced anxiety and pain in pregnant women, shortened the three stages of labor, and increased satisfaction with childbirth [25]. The results of this study are consistent with the results of the present study, although the target groups are different. Based on the results obtained, studies can be designed to investigate the effect of Parr's reflexology massager on reducing pain in other patients.

In terms of fatigue, the results showed that massage had a short-term effect, particularly immediately after the intervention and at 60 and 90 minutes afterward; however, no significant difference was observed between the groups at 24 hours. This finding indicates that the beneficial effects of reflexology on fatigue are transient and limited to the immediate postoperative period. These findings are also consistent with other studies, which have shown that reflexology massage can be effective in reducing fatigue [12, 26]. However, the relatively smaller effect sizes observed for fatigue compared to pain suggest that reflexology may have a stronger immediate impact on pain than on perceived fatigue. In a large review study that examined the effect of massage on fatigue, it was shown that massage can be used as a low-cost, safe, and easy method to reduce fatigue in patients, especially dialysis patients and those with chronic heart failure [12].

A systematic review of recent research trends and perspectives on foot reflexology found that foot reflexology is a non-invasive complementary therapy that modern people have increasingly accepted in recent years. To understand research trends and perspectives on foot reflexology over the past 31 years, this study used the Web of Science main collection as a data source and two

visualization tools, COOC and VOSviewer, to analyze literature related to foot reflexology from 1991 to 2021. The study found that foot reflexology has a moderating effect on anxiety, fatigue, and cancer, and is the subject of ongoing and future research [27].

In terms of demographic characteristics, homogeneity was observed between the intervention and control groups in the variables of age, sex, marital status, education level, surgical history, and type of surgery. This homogeneity provides greater confidence in interpreting the study's results and conclusions, as baseline differences between groups have been reduced and the observed effects can be partially attributed to the massage intervention.

This study suggests that complementary therapies such as foot reflexology massage may help improve short-term postoperative outcomes by alleviating pain and fatigue in the immediate recovery period. While the findings indicate potential value for supporting early postoperative care, the evidence is limited to short-term effects. However, the absence of significant effects at 24 hours suggests that these benefits are transient and may not persist beyond the immediate postoperative period. Therefore, these results should be interpreted with appropriate caution, and further research is needed to clarify the broader clinical implications.

Several limitations of the present study warrant consideration. First, the single-center design and relatively small sample size may limit the generalizability of the findings. Second, the inherent nature of the reflexology intervention precluded the blinding of participants and therapists, which may introduce potential biases. Furthermore, owing to cultural considerations within the community, gender-concordant therapists (one male, one female) administered the intervention. Although standardized massage techniques were strictly followed, inadvertent variations in the applied pressure cannot be entirely ruled out.

Additionally, the psychological influence of the therapists' presence on the subjective perception of pain, a phenomenon heavily modulated by emotional and psychological factors, cannot be disregarded. Finally, the study was limited to a short-term evaluation period; the lack of a long-term follow-up restricts conclusions regarding the sustained efficacy of the intervention. Future multi-center studies with larger cohorts and extended follow-ups are warranted. To minimize intervention variability, utilizing a single therapist or a single-gender cohort is also recommended.

Conclusion

This randomized controlled trial provides preliminary evidence that foot reflexology may transiently attenuate nociceptive pain and fatigue during the acute postoperative phase following lumbar spine surgery. However, the absence of significant effects at the 24-hour follow-up indicates that these benefits are short-lived. While significant reductions were observed in the early post-intervention period, these effects were not maintained at the 24-hour follow-up. Given its non-invasive and cost-effective profile, reflexology may be considered a supplemental non-pharmacological modality. Nonetheless, rigorously designed investigations with larger cohorts and extended follow-ups remain necessary to establish its longitudinal clinical utility definitively.

Ethical Considerations

The study was carried out in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Yazd University of Medical Sciences with the Ethics Code: IR.SSU.REC.1395.239 (Webpage of ethical approval code is: https://ethics.research.ac.ir/PortalCommittee.php?code=IR.SSU.MEDICINE.REC) as well as confirmed that all research was performed in accordance with relevant guidelines/regulations.

The trial is registered at www.irct.ir under the identification number IRCT20181111041608N1. All protocols were approved by the Ethics Committee of Yazd University of Medical Sciences and the Clinical Trials Center of the Ministry of Health of Iran.

Before the start of the study, the objectives of the research were explained to the participants, and if the

patients were willing to participate, written informed consent was obtained from them.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Authors' Contributions

Conceptualization: M. Javadi, S.E. Hosseini
Methodology (Study Design): M. Javadi
Investigation (Data Collection): M. Amirpour
Formal Analysis (Data Analysis): S.E. Hosseini
Writing – Original Draft: M. Javadi, S.E. Hosseini
Writing – Review & Editing: M. Javadi, S.E. Hosseini
All authors read and approved the final manuscript.

Artificial Intelligence Utilization

The article was not written using artificial intelligence.

Data Availability Statement

The data analyzed during this study are available from the corresponding author on reasonable request.

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