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THE EFFECT OF DEEP BREATHING RELAXATION TECHNIQUES AND COLD COMPRESS TECHNIQUES ON PAIN LEVELS IN PATIENTS AFTER CRURAL FRACTURE SURGERY

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Abstract

Background: Postoperative pain is a major complication following cruris fracture surgery. Non-pharmacological interventions such as deep breathing, relaxation, and cold compress therapy are widely used, but their comparative effects remain unclear.

Objective: To compare the effectiveness of deep breathing relaxation and cold compress therapy in reducing postoperative pain among cruris fracture patients at Kustati Surakarta General Hospital.

Methods: A quasi-experimental pretest–posttest two-group study involving 40 postoperative patients using total sampling. Pain was measured using the validated Numeric Rating Scale. Kruskal–Wallis and Wilcoxon tests were applied.

Result: Both interventions significantly reduced pain levels ($p < 0.05$). Cold compress therapy demonstrated a greater decrease.

Conclusion: Both interventions were associated with decreased postoperative pain, with cold compress therapy showing greater reduction. Further randomized studies are recommended.

INTRODUCTION

Fractures remain a global health burden, affecting approximately 440 million people worldwide in 2022. In Indonesia, fracture incidence remains high with significant morbidity and psychological impact. Postoperative pain is often undertreated, contributing to delayed recovery and reduced mobility. The most frequent anatomical locations for fractures are the patella, tibia or fibula, and ankle (Wu et al., 2021). Meanwhile, in Indonesia, the incidence of fractures is quite high. According to data from the Ministry of Health of the Republic of Indonesia in 2023, it was found that among all accidents that occurred, 5.8% of the injured victims, or approximately 8 million people, experienced fractures due to various causes and types. The most common fractures occurred in the upper extremities (36.9%) and lower extremities (65.2%), while 5.8% were closed fractures. Among all fracture cases, limb fractures

were the most common, accounting for around 643 cases (48.64%). The survey results from the Ministry of Health team showed that 25% of fracture patients experienced death, 45% suffered physical disabilities, 15% experienced psychological stress such as anxiety or even depression, and 10% recovered well (Ministry of Health RI, 2023).

Postoperative pain is often poorly managed in a large number of patients and is associated with various negative consequences, including increased morbidity, the development of chronic postoperative pain, functional impairment, delayed recovery, decreased quality of life, prolonged opioid use, and higher medical costs (Wu et al., 2022). Good postoperative pain management reduces pain levels and leads to benefits such as earlier mobilization, shorter hospital stays, lower treatment costs, and increased patient satisfaction (Rahman et al., 2025). The goal of postoperative pain management is to reduce or eliminate unpleasant experiences with minimal side effects and maximum cost-effectiveness (Yuliana et al., 2022).

Appropriate nonpharmacological interventions can reduce patients' post-surgical pain (Tololiu et al., 2023). A simple yet effective approach to pain management is the use of deep breathing techniques. However, there has not been sufficient research discussing the impact of deep breathing techniques on patients' perceptions of pain (Patil et al., 2022). A study by Wang et al. (2024) suggested that combining targeted nursing measures, including medication administration, cold therapy, and nonpharmacological techniques, can effectively complement medical and surgical interventions to provide comprehensive pain management for patients with extremity fractures.

Poorly managed acute postoperative pain can contribute to the occurrence of prolonged postoperative pain. Clinical factors such as gender, where women tend to report more intense pain than men, can influence pain perception. The type of surgery performed also affects pain intensity, as more invasive or complex procedures can cause greater pain and influence recovery. Longer anesthesia duration may lead to slower recovery and potentially increased postoperative pain. In addition, pain catastrophizing (a cognitive process in which individuals perceive pain as extremely threatening and intolerable) can worsen pain perception, prolong pain duration, and increase the risk of chronic postoperative pain. These factors interact with one another, making effective postoperative pain management essential to prevent the development of persistent pain (Mi et al., 2021).

A preliminary study showed that the number of fractures at Kustati Hospital, Surakarta, in August 2025 was 97 cases. It was also found that most respondents experienced moderate to severe pain, with an intensity level of 6–7 on the Numeric Rating Scale (NRS). The reported healing duration among patients was about 1–2 months. So far, in addition to analgesic drugs, cold compresses and relaxation therapy have been used as additional measures to reduce pain. However, these methods seem not to be very effective, as patients often still complain of pain and request additional painkillers beyond the prescribed dosage.

Non-pharmacological interventions such as deep breathing relaxation and cold compress therapy are commonly used, yet comparative evidence in postoperative cruris fracture patients is limited. This study aims to compare the effectiveness of these two interventions.

METHODS

Study Design

This study used a quasi-experimental pretest–posttest two-group design. Patients who had undergone cruris fracture surgery were divided into two groups: one group received deep breathing relaxation techniques, and the other received cold compresses. Pain levels in both groups were measured before and after the intervention.

Settings

This study was conducted over one month, namely in September 2025, at Kustati Hospital in Surakarta.

Research subject

The population consists of patients who underwent cruris fracture surgery at the Kustati Surakarta General Hospital. The sample consists of patients who underwent cruris fracture surgery, agreed to participate, and met certain criteria (adulthood, stable post-surgical condition, and willingness to undergo intervention). According to Brysbaert (2019), the minimum sample size for experimental research is 15 in each research group. Therefore, the researcher decided to take a sample size of 20 patients in each research group for this study. Thus, the total sample size for this study was 40 patients. The study used a sampling concept with non-probability sampling of the Total Sampling type to select post-operative patients with cruris fractures.

Instruments

The intensity of the patient's pain was measured using a Numeric Rate Scale, with scores ranging from 0 (no pain) to 10 (severe pain).

Data Collection

Deep breathing techniques were performed by patients under the guidance of nurses 3-4 hours after surgery for 15 minutes, twice a day, and performed twice in a row

Application of cold compresses at a temperature of 5-10°C using cold water to the area near the fracture for muscle relaxation is performed 7-8 hours after surgery for 10-15 minutes, twice a day, for two consecutive days.

The intensity of the patient's pain was measured using a Numeric Rate Scale, with scores ranging from 0 (no pain) to 10 (severe pain).

Data Analysis

In this study, several analytical tests will be conducted, namely the Normality Test, which is used to determine whether the data is normally distributed before further analysis. The Statistical Test for comparing the average change in the pain scale between groups is the Kruskal-Wallis Test. Paired

T-Test or Wilcoxon analysis will be performed to assess the differences between the pre-test and post-test in each group. Paired t-test is used for normal data, and the Wilcoxon signed-rank test for non-parametric data. All the test was conducted using SPSS version 22.

Ethical Consideration

All participants received complete information regarding the study's purpose, procedures, benefits, and potential risks before giving written informed consent. Participation was entirely voluntary, and respondents had the right to withdraw at any time without consequence. To ensure anonymity, personal identities were kept confidential, and only aggregated data were presented in reports. All collected information was stored securely in encrypted form and accessible only to the research team. Data were maintained for analysis and later destroyed or archived according to institutional guidelines. The study design minimized potential risks or discomfort by using safe, noninvasive interventions such as deep breathing relaxation and cold compresses. Ethical approval was obtained from the institutional ethics committee to ensure that the research met all ethical standards and protected participants' rights, safety, and well-being. This study was registered by Universitas Strada's ethical committee with the registration number 0923476/EC/KEPK/I/09/2025.

RESULTS

Characteristics of Respondents

Table 1. Characteristics of Respondents (n = 40).

Characteristics		Frekuensi (n)	Mean (Std)	Percentage (%)
Age		-	45.70 (18.22)	
Gender	Male	24	-	60.0
	Female	16	-	40.0

The average age of respondents was 45.70 (18.22), with the youngest being 20 years old and the oldest being 80 years old. The majority of respondents were male (60.0%) (See table 1).

Changes in Pain Scale between Groups

Table 2. Changes in Pain Scale between Groups (n = 40).

Group	Mean	Sig.
Deep breathing therapy before intervention	62.50	0.000
Cold compress therapy before intervention	58.50	
Deep breathing therapy after intervention	22.10	
Cold compress therapy after intervention	18.90	

Table 2 shows the changes in pain levels among patients receiving deep breathing therapy and cold compress therapy. Before the intervention, the mean pain score for the deep breathing group was 62.50, while the cold compress group recorded a slightly lower mean of 58.50. After the intervention,

both groups showed a marked decrease in pain intensity. The mean pain score in the deep breathing group dropped to 22.10, and in the cold compress group to 18.90. Statistical analysis indicated a significant difference ($p = 0.000$), demonstrating that both interventions effectively reduced pain, with the cold compress therapy showing a slightly greater reduction in pain levels.

The Effect of Breathing Relaxation Compared with Cold Compresses Techniques on Pain Levels in Patients After Cruris Fracture Surgery

The Wilcoxon test results in Table 3 show that the pain scale score after deep breathing therapy intervention is lower than the pain scale score before deep breathing therapy intervention, indicating that there is an effect between deep breathing therapy and a decrease in pain scale in crural fractures (p value = 0.000; p value < 0.05). The pain scale score after cold compress therapy intervention was lower than the pain scale score before cold compress therapy intervention, indicating that there is an effect between cold compress therapy and a decrease in pain scale in crural fractures (p value = 0.000; p value < 0.05).

Table 3. The Effect of Breathing Relaxation Compared with Cold Compresses Techniques on Pain Levels in Patients After Cruris Fracture Surgery

	Breathing Relaxation Group	Cold Compresses Group
Z	-3.993	-4.093
Asymp. Sig. (2-tailed)	0.000	0.000

DISCUSSION

The results of this study showed that the level of pain in cruris fracture patients before receiving deep breathing intervention was in the severe category, while after the intervention, the pain level decreased to mild or even no pain. Statistical analysis indicated a significant effect of deep breathing relaxation therapy on reducing postoperative pain in cruris fracture patients. From these findings, it can be concluded that deep breathing relaxation is effective in lowering pain intensity from severe to mild, although the maximum effect (no pain) was not fully achieved in all respondents. This finding aligns with the theory proposed by Potter & Perry (2017), which states that relaxation and deep breathing techniques can reduce pain by decreasing sympathetic nervous system activity and enhancing individual control over pain sensations. Thus, this intervention is appropriate as a supportive nonpharmacological therapy in pain management for fracture patients.

These findings are supported by Kusyani et al. (2024), who reported that before receiving deep breathing relaxation therapy, 50% of respondents experienced severe pain, but after the intervention, 83% experienced moderate pain. Similarly, Ambohamsah et al. (2024) found that breathing relaxation techniques effectively reduced pain intensity in patients with fractures. In addition, Purnamasari et al. (2023) explained that combining deep breathing relaxation with visualization and music reduced pain

levels from moderate–severe to mild–moderate, with a p-value of $0.000 < \alpha = 0.05$, indicating statistically significant results.

A fracture is a disruption in bone continuity, either partial or complete, often accompanied by damage to surrounding soft tissue. One of the main clinical manifestations in fracture patients is pain, which arises due to nociceptor stimulation by inflammatory chemicals such as prostaglandins, bradykinin, and histamine at the site of bone injury (Court-Brown & Caesar, 2006). Physiologically, deep breathing is a nonpharmacological relaxation therapy that works by increasing tissue oxygenation, stimulating the parasympathetic nervous system, and decreasing sympathetic activity related to pain perception. This process helps the body reach a relaxed state, thereby increasing the pain threshold and reducing pain perception. Deep breathing also enhances the release of endogenous endorphins that act as natural analgesics, helping divert the patient's focus from pain to relaxation and self-control (Sunadi et al., 2020). However, the study by Hu et al. (2025) highlighted that the effectiveness of deep breathing exercises may depend on the duration and consistency of practice, especially among pediatric patients. This suggests that to achieve optimal results, deep breathing interventions should be performed frequently and consistently, accompanied by adequate patient education and guidance.

The study also revealed that the level of pain in cruris fracture patients before receiving cold compress intervention was in the severe category, while after the intervention, pain decreased to mild or even no pain. Statistical analysis also showed a significant effect of cold compress therapy on the pain level of postoperative cruris fracture patients. These findings are reinforced by Kaur et al. (2018), who stated that cold compress therapy significantly reduced pain intensity compared to relaxation interventions in patients with acute musculoskeletal injuries. Similarly, Lubis et al. (2021) found a significant difference in pain intensity before and after cold compress intervention, with a p-value of 0.001 (<0.05). Their study also showed a significant difference between cold compress and standard hospital interventions in reducing pain among fracture patients. Jerliawanti & Pipin (2023) reported similar findings, showing that before cold compress therapy, pain scores were in the moderate–severe range (7 and 9), but after intervention, they decreased to moderate levels (5 and 6). This supports the conclusion that cold compress therapy effectively reduces pain intensity in patients with closed fractures in emergency settings. Furthermore, Khasanah et al. (2021), in a literature review, reported that the mean pain score before intervention was 6.72, while after cold compress application, it dropped to 3.50 with a p-value of 0.000, indicating that cold compress therapy effectively reduced pain levels in patients with closed fractures. Nurlela et al. (2023), in a systematic review, also confirmed that cold compress therapy at a temperature of 5–10°C for 10–15 minutes effectively reduced pain and swelling and could be used as an adjunct nonpharmacological therapy for fracture patients.

A fracture is a break in bone continuity caused by trauma or excessive pressure, accompanied by an inflammatory response in the damaged tissue area. One of the primary symptoms in fracture patients is pain, triggered by the release of inflammatory mediators such as prostaglandins, serotonin, and histamine that stimulate pain receptors (nociceptors) (Court-Brown & Caesar, 2006). Cold

compress therapy is a nonpharmacological method that works by lowering local tissue temperature, causing vasoconstriction, which reduces capillary permeability and tissue edema. This physiological effect decreases metabolic activity in the injured area, slows nerve impulse conduction, and increases the patient's pain threshold. Cold compresses also produce a mild local anesthetic effect, reducing pain sensation by inhibiting the transmission of pain impulses from the periphery to the central nervous system. In nursing practice, this therapy can serve as an independent intervention to help control acute pain without the side effects of medication (Suryani & Soesanto, 2020).

Cold compresses work by reducing local tissue temperature, resulting in vasoconstriction and decreased blood flow to the injured area. This mechanism helps reduce inflammation, edema, and sensory nerve activity transmitting pain impulses to the brain. According to Kristanto & Arofiati (2016), applying cold compresses to postoperative fracture patients reduced pain intensity faster than deep breathing relaxation techniques. Their findings showed an average decrease of three points on the pain scale after cold compress application, compared to only one point in the deep breathing group.

Meanwhile, the deep breathing relaxation technique focuses more on the psychological and physiological aspects of the patient. This technique stimulates the parasympathetic nervous system, which helps reduce muscle tension, lower anxiety, and slow heart rate, resulting in a lighter pain perception (Yoli et al., 2024). Rustiawati et al. (2022) also found that deep breathing exercises significantly reduced postoperative pain levels. This effect arises from increased tissue oxygenation and the release of endorphins, which act as the body's natural analgesics.

The results of this study showed that most respondents in the cold compress group experienced a decrease in pain from severe to mild or even no pain, while some respondents in the deep breathing group remained in the mild pain category. This strengthens the notion that cold compress intervention is more effective in reducing acute pain after fractures because it acts locally and physiologically at the pain source rather than only affecting pain perception.

This finding aligns with the theory of physiological analgesia proposed by Guyton and Hall (2016), which states that lowering tissue temperature can inhibit the speed of pain nerve conduction and reduce the metabolic activity of cells involved in inflammation. Therefore, it can be concluded that cold compress therapy has a faster and more pronounced analgesic effect than deep breathing therapy, especially in conditions of acute pain following bone trauma.

LIMITATION

There are several limitations to this study. First, although all respondents received the same type and dose of pain medication as prescribed by their doctors, the pharmacological effects could still influence individual pain perceptions and measurement results after non-pharmacological intervention. Second, the data collection process was conducted in a fairly crowded inpatient room, so there was the possibility of disturbances from the surrounding environment, such as noise, medical staff activities, and interactions with family members, which could affect the respondents' concentration when

performing deep breathing relaxation techniques. Third, variations in pain perception among respondents: pain is subjective and greatly influenced by psychological factors and each patient's pain tolerance threshold, so even though standard measurement instruments were used, there was still the potential for bias in pain scale assessments. Finally, factors related to activities and family visits: Routine care activities and family visit times cannot be fully controlled during the study, which may affect the patient's comfort and relaxation levels during the intervention.

CONCLUSION

The results of this study indicate that deep breathing therapy significantly reduces pain scores in patients with crural fractures. Cold compress therapy significantly reduces pain scores in patients with crural fractures, and there is a significant difference between the average change in pain scores in the deep breathing therapy group and the cold compress therapy group, with a greater reduction in pain scores seen in the cold compress therapy group compared to the deep breathing therapy group.

For medical personnel, it is recommended to use deep breathing therapy and cold compresses as non-pharmacological interventions to reduce pain in patients with crural fractures. Hospitals need to support the implementation of this simple therapy by providing facilities, training, and standard operating procedures (SOPs) for optimal implementation. For future researchers, it is recommended to conduct studies with larger sample sizes, use different research designs, and compare this intervention with pharmacological therapy or a combination of both to strengthen its effectiveness.

AUTHOR CONTRIBUTION

Yunnita Setiyaningsih: Conceptualized the idea, collected data, and wrote the manuscript.

Agusta Dian Ellina: Assisted in guiding the research design, data collection, and manuscript writing stages.

Rahmania Ambarika: Assisted in guiding the research design, data collection, and manuscript writing stages.

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Yunnita Setiyaningsih : None.

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Rahmania Ambarika : None.

CONFLICT OF INTEREST

No conflict of interest.

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