

Effectiveness of Foot Muscle Isometrik Exercise on Pain Severity of Patients with Lower Limb Fractures

¹Wandi Wandu, ²Dian Anggraini

¹Bachelor Student of STIKep PPNI Jawa Barat, Bandung

²Department of Nursing of STIKep PPNI Jawa Barat, Bandung



Proceeding STIKep PPNI Jawa Barat

Website :

<https://proceedings.stikep-ppnijabar.ac.id/index.php/psj>

Volume 1 (1), 168-173

Article info

Received : December 28, 2024

Revised : April 22, 2025

Accepted : May 02, 2025

Published : May 19, 2025

Corresponding author

Wandi

Sekolah Tinggi Ilmu Keperawatan PPNI Jawa Barat, Bandung, Indonesia

Jl. Muhammad No 34 Bandung, Indonesia

Citation

Wandi, & Anggarini, D. (2025). Effectiveness of Foot Muscle Isometric Exercise on Pain Severity of Patients With Lower Limb Fractures. *Proceeding STIKep PPNI Jawa Barat*, 1(1), 168-173.

This is an **Open Access** article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License



INTRODUCTION

According to (Smeltzer, 2001) a fracture is a condition in which there has been a discontinuity of bone tissue, due to direct trauma, or a pathological condition, and can be determined according to the extent and type of fracture. According to (Eugenia, 2022) in Indonesia, 46.2% of fractures occur in the lower extremities. Adult males (60.7%) are the most frequent patients undergoing orthopaedic surgery in the inferior

extremities. The inflammatory process in patients who have a fracture will result in pain and swelling in the fracture area. (Andri, 2019) said that 60% of fracture patients complained of severe pain. According to (Tournaire, 2007) pain is an unpleasant feeling both sensory and emotional related to threats or damage to body tissues. The patient will be uncomfortable with the feeling of pain, the ROM in the patient's joints will be limited, and it can cause contractures or

Abstract

Objective: To identify the effect of foot muscle isometric exercise on pain severity of patients with lower limb fractures.

Method: A quasi-experimental research design was employed using a two-group pre-test and post-test approach. A total of 42 participants were selected through convenience sampling. The intervention group received foot muscle isometric exercise, while the control group did not. Pain intensity was measured using the Numeric Rating Scale (NRS), a widely used tool for assessing pain severity in both clinical and research settings. Data analysis was conducted using the independent t-test to evaluate differences between the two groups.

Results: The demographic data indicated that the majority of participants were male in both the control group (71.4%) and the intervention group (90.5%). The most common surgical procedure was open reduction and internal fixation (ORIF), performed in 57.1% of the control group and 47% of the intervention group. The findings revealed a statistically significant difference in postoperative pain scores between the two groups, with a p-value of 0.00 ($p < 0.05$), indicating the effectiveness of isometric exercises in reducing pain.

Conclusion: The study suggests that foot muscle isometric exercises are effective in reducing postoperative pain. Future research should investigate its effectiveness in patients with higher pain severity, long-term outcomes, and its integration with other non-pharmacological pain management strategies.

Keywords: Foot_muscle, isometric_exercise, fracture, lower extremity, pain

neurovascular disorders. Patients who should have learned to learn ambulation and mobilization according to the program could not do it, because of pain. The problem will prolong the length of stay (LOS) of the patient, so other complications such as: deep vein thrombosis (DVT), constipation, pulmonary embolism, osteomyelitis, contractures or other diseases may appear. Being free of pain is a right for everyone, pain is the fifth sign that must be considered in patients with fractures. Pharmacological and non-pharmacological pain therapies can be used to manage the pain of patients with fractures. Pharmacological pain therapy is an effort to control, reduce or eliminate pain sensations using drugs (Haryani, Tandy, Vania and Barus, 2018). Pain management in postoperative orthopedic patients remains a critical aspect of recovery, particularly among individuals with lower extremity fractures. According to Permata (2014), a study at Dr. Kariadi Hospital in Semarang involving 233 orthopedic patients found that ketorolac 30 mg administered intravenously for two days was the most commonly used analgesic. Eugenia (2022) further noted that pharmacological approaches help reduce pain by blocking stimulation at peripheral nerve endings. Handayani (2019) reported that ketorolac 30 mg every 8 hours could reduce pain from moderate to mild in 45.2% of patients, while 51.6% experienced no change, and 3.2% continued to have severe pain. While pharmacological treatments are common, non-pharmacological methods are increasingly recognized. Haryani et al. (2018) emphasized the use of complementary therapies, such as relaxation and distraction, in non-pharmacological pain control. According to NAON (2001), distraction and relaxation are most frequently used in fracture patients, while other methods—such as traction maintenance, mobilization, CBT, and isometric or isotonic exercises—are less common. Isometric exercises, including foot muscle isometric exercise, have shown

promise. Perry and Potter (2002) listed seven types of isometric exercises, each offering specific benefits. Khosrojerdi (2018) found significant reductions in pain scores among patients with lower extremity fractures ($p < 0.001$). Supporting studies by Amatiria (2013), Kurniawati (2023), and Thoiyah (2023) confirmed the efficacy of isometric exercise in reducing pain and accelerating recovery. Rio (2017) also demonstrated that isometric exercises provided superior analgesic effects compared to isotonic ones ($p = 0.002$). Foot muscle isometric exercise involves muscle contraction without joint movement, typically held for 5–15 seconds, aimed at pain relief and improved circulation (Achi, 2020). At Kemuning Ward, Hasan Sadikin Hospital, pharmacological and non-pharmacological pain management is provided, yet some patients continue to report pain. This gap prompted the researcher to explore the effectiveness of foot muscle isometric exercise in reducing pain among patients with lower extremity fractures.

METHODS

Study design

This research employed a quasi-experimental design using a two-group pre-test and post-test method to assess the impact of foot muscle isometric exercise on pain intensity among patients with lower limb fractures. The design enabled comparison between an intervention group receiving the exercise and a control group without intervention. This approach allowed the researcher to measure changes in pain levels before and after the intervention within and between both groups.

Population and Sample

The population in this study consisted of patients hospitalized on the second floor of the Kemuning Ward at Hasan Sadikin Hospital. A total of 42 participants were selected using convenience sampling, with sample size determined via G*Power software (version 3.1.9.4) using a t-test, effect size 0.8, alpha

0.05, and power 0.8. Respondents were divided equally into control and intervention groups. Inclusion criteria included lower extremity fractures, mild to moderate pain, third postoperative day, and no analgesic use. Exclusion criteria were severe pain, drug addiction, chronic diseases, spinal injuries, or neurological deficits in the lower extremities.

Instrument

The Numeric Rating Scale (NRS) was utilized to assess pain intensity in clinical and research contexts. It consists of an 11-point scale, where respondents rate their pain from 0 (“no pain”) to 10 (“worst pain imaginable”) (Jensen et al., 2003). The score directly reflects symptom severity, with higher values indicating greater pain. The NRS has demonstrated excellent reliability and validity across various settings. Test-retest reliability is high, with correlation coefficients often exceeding 0.90 (Ferreira-Valente et al., 2011). Additionally, strong correlations with the Visual Analog Scale (VAS) and Verbal Descriptor Scale (VDS) support its criterion and construct validity.

Procedure intervention

Following the pre-test, the intervention was

conducted over two consecutive days, from postoperative day (POD) 3 to POD 4. Both groups were initially assessed for pain using the Numeric Rating Scale (NRS), and results were recorded. The intervention group received education on postoperative pain management and foot muscle isometric exercise, followed by training—10 repetitions per session, four times daily, for two days. If pain increased, the session was paused for 10 minutes. Pain levels before and after the intervention were documented. The control group received standard nursing care without the exercise. After the post-test, all patients were educated using instructional video.

Data analysis

The data analysis in this study involved two main methods: frequency distribution and paired sample t-test. Frequency distribution was used to describe the demographic characteristics of the respondents, such as age, gender, and type of surgery. The paired sample t-test was applied to evaluate the difference in pain scores before and after the intervention within each group, allowing the researcher to assess the effectiveness of isometric exercise in reducing pain intensity.

RESULTS

Table 1. Characteristics of the Respondents (N=42)

Characteristic	Control Group (N=21)	Intervention Group(N=21)
	Frequency (%)	Frequency (%)
Age		
Mean Score (±SD)	31.29 (±SD 13.395)	39.38 (±SD 17.331)
Range	15-64	10-66
Gender		
Male	15 (71.4%)	19 (90.5%)
Female	6 (28.6%)	2 (9.5%)
Type of Operation		
ORIF	12 (57.1%)	10 (47.6%)
ORIF	9 (42.9%)	11 (52.4%)

This study consisted of two groups: a control group and an intervention group, each with 21 participants. The average age in the control group was 31.29 years (SD ±13.395), while the

intervention group had a higher average age of 39.38 years (SD ±17.331). Most participants were male, comprising 71.4% in the control group and 90.5% in the intervention group. Regarding surgery type, 57.1% of the control group underwent Open Reduction Internal Fixation (ORIF) and 42.9% underwent Open Reduction External Fixation (OREF). In the intervention group, 47.6% had ORIF and 52.4% received OREF procedures.

Table.2 effectiveness of Foot Muscle Isometric Exercise on Pain Severity of Patients with Lower Limb Fractures

Pain	Pre-test		Post-test		T	Mean Difference	P-value
	Mean Score (± SD)	Range	Mean Score (± SD)	Range			
Intervention Group (n=21)	4.38 (± SD 1.071)	2-6	1.62 (± SD 0.71)	0-4	16.471	-2.714	0.001
Control Group (n=21)	4.00 (± SD 1.225)	2-6	3.95 (± SD 1.071)	2-6	0.295		

The study evaluated the effectiveness of foot muscle isometric exercise in reducing pain among patients with lower limb fractures by comparing pre-test and post-test pain scores using the Numeric Rating Scale (NRS).

In the intervention group (n=21), the average pre-test pain score was 4.38 (±1.071), decreasing significantly to 1.62 (±0.71) after isometric exercise, with a T-value of 16.471 and a mean difference of -2.714. The result was statistically significant (p = 0.001). Conversely, the control group (n=21) showed minimal change, with pre- and post-test scores of 4.00 (±1.225) and 3.95 (±1.071), respectively, and a T-value of 0.295. These findings indicate that foot muscle isometric exercise is effective in significantly reducing postoperative pain in patients with lower limb fractures.

DISCUSSION

The results showed that foot muscle isometric exercise significantly reduced pain levels. Most respondents (57.1%) underwent ORIF surgery and reported moderate pain, differing from Andri (2019), who found that 60% of fracture patients complained of severe pain. This difference can be attributed to the inclusion

criteria and study conditions; Andri (2019) focused on patients with lower extremity or long bone fractures with a two-day length of stay (LOS), while this study excluded patients with severe pain and implemented interventions starting on post-operative day (POD) III. The highest reported pain score in both groups was 6; however, after the intervention, a notable reduction in pain scores was observed. In the intervention group, the mean difference between pre- and post-intervention pain scores was -2.76, with a p-value of 0.001, indicating a significant effect of foot muscle isometric exercise on reducing pain in patients with lower extremity fractures. This aligns with findings by Khosrojerdi (2018), who reported a significant reduction in pain scores from a pre-test mean of 6.86 to a post-test mean of 2.86 (p < 0.001), supporting the effectiveness of isometric exercises in pain relief and recovery acceleration.

Manual calculations showed that moderate pain levels (pre-test scores of 4–6) were reduced to 0 (no pain) following the intervention, demonstrating the high effectiveness of foot muscle isometric exercise for patients with moderate pain. The reduction

in pain can be attributed to improved leg muscle function and enhanced venous return, leading to a faster resolution of the inflammatory process, which reduces pain and swelling (Kluwer, 2018). Inflammation releases chemical mediators that stimulate pain; by decreasing this stimulation, isometric exercises reduce pain transmission through C fibers and activate beta A fibers. This dominance of beta A fibers generates gate closure as per the Gate Control Theory, further minimizing pain perception.

Additionally, isometric foot muscle exercises induce distraction and relaxation effects. As noted by Smeltzer (2002), distraction reduces pain perception by activating the descending inhibitory system, decreasing the pain signals sent to the brain. Furthermore, these exercises increase endorphin levels, which act as neurotransmitters and neuromodulators to suppress pain sensation at synaptic junctions (deGroot, 1997). In contrast, the control group showed only a slight average reduction in pain scores (-0.05) with a p-value of 0.001. While the control group experienced some reduction in pain, it was minimal compared to the intervention group, likely due to standard nursing care interventions provided to all patients. These findings highlight the significant benefits of foot muscle isometric exercise in managing pain and promoting recovery in patients with lower extremity fractures.

CONCLUSION

Foot muscle isometric exercise is an effective intervention for reducing pain in patients with lower extremity fractures, especially those experiencing moderate pain. It works by enhancing muscle activity, improving circulation, and influencing pain perception through physiological mechanisms like the Gate Control Theory and endorphin release. Clinically, incorporating this exercise into postoperative care may improve pain management. Future research should assess its long-term benefits and integration with other

non-pharmacological strategies.

Acknowledgement

The researcher sincerely thanks the patients and staff of Kemuning Ward, Hasan Sadikin Hospital, as well as the hospital administration, supervisors, and colleagues for their support, guidance, and contributions.

Conflict of Interest

The author declares no conflict of interest related to the conduct, authorship, or publication of this study.

REFERENCES

- Amatiria, G. (2013). Pengaruh latihan isotonik dan isometrik terhadap penurunan rasa nyeri pasien fraktur femur.
- Andarmoyo, S. (2013). Konsep dan proses keperawatan nyeri. Yogyakarta: Ar-Ruzz Media.
- Andri, J. (2019). Hubungan antara nyeri fraktur dengan kualitas tidur pasien yang dirawat inap.
- Anggreini, S. (2023). Penerapan latihan isometrik untuk mengatasi nyeri pada lansia dengan osteoarthritis.
- Bement, M. H. (2008). Dose response of isometric contractions on pain perception in healthy adults.
- Crocker, T., Young, J., Forster, A., & Bement, M. H. (2008). Dose response of isometric contractions on pain perception in healthy adults.
- Eugenia, M. (2022). Karakteristik nyeri pasca-operasi ortopedi di RSUP Sanglah.
- Handayani, S. (2019). Kajian penggunaan analgetik pada pasien pasca bedah fraktur di Trauma Centre RSUP M. Djamil Padang.
- Khosrojerdi, H. (2018). The effect of isometric exercise on pain severity and muscle strength of patients with lower limb fractures.
- Kurniawati, A. (2023). Pengaruh pemberian quadriceps isometric exercise terhadap perubahan nyeri.

- Marannu, A. (2021). Medical rehabilitation in patient with right tibial plateau fracture.
- Nurhanifah, D. (2022). Manajemen nyeri non farmakologi. Urban Green.
- Permata, V. A. (2014). Penggunaan analgesik pasca operasi ortopedi di RSUP Dr. Kariadi Semarang.
- Prasetyo, S. N. (2023). Konsep dan proses keperawatan nyeri. Yogyakarta: Graha Ilmu.
- Pratitdya, G. (2020). Perbandingan interpretasi skala nyeri antara NRS-VAS-WBPS oleh pasien pasca operasi elektif ortopedi di RSUD Dr. Sutomo.
- Rahmaniyah, S. (2022). Pengaruh isometric exercise terhadap perubahan nyeri lutut.
- Rangga, B. (2022). Pengembangan fitness. DIY Yogyakarta: Samudra Biru.
- Rio, E. (2015). Isometric exercise induces analgesia and reduces inhibition in patellar tendinopathy.
- Rio, E. (2017). Isometric contractions are more analgesic than isotonic contractions for patellar tendon pain.
- Rosyidi, K. (2021). Muskuloskeletal. Jakarta: Trans Info Media.
- Sara, A. (2015). Effect of isometric exercises on primary dysmenorrhea: A randomized controlled clinical trial.
- Susanto, A. W. H. (2022). Keperawatan medikal bedah. Padang, Sumatera Barat: PT Global.
- Syahputra, I. (2021). Pengaruh program latihan isometrik dan isotonik terhadap peningkatan kekuatan otot quadriceps pada pasien osteoarthritis (OA) lutut di Praktek Singgasan Rama Blitar.
- Taufik, N. H. (2019). The effect of isometric exercise plantar flexor on osteoblast activity measured by bone-specific alkaline phosphatase and callus formation in a patient post open reduction internal fixation with non-articular tibia fracture.
- The National Association of Orthopaedic Nurses. (2001). Core curriculum for orthopaedic nursing (4th ed.). Chicago: National Association of Orthopaedic Nurses.
- Thoiyah, L. (2023). Gambaran pelaksanaan latihan isometrik pada pasien post operasi fraktur ekstremitas bawah.