

OPTIMIZING BALANCE AND COORDINATION THROUGH INTEGRATED PHYSICAL EXERCISE IN PATIENTS FOLLOWING FRACTURE SURGERY

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ABSTRACT

Background: The high incidence of traffic accidents has led to a significant increase in fractures, particularly of the lower extremities, many of which require treatment through Open Reduction and Internal Fixation (ORIF) procedures. Post-ORIF patients commonly experience pain and fear in performing daily activities, including impaired balance and coordination. To address this condition, a structured and progressive integrated physical exercise intervention is necessary. This study aims to evaluate the impact of an integrated intervention that combines physical activity, pain management, and enhancement of fall efficacy on the functional status of patients recovering from lower extremity fracture surgery using the Open Reduction and Internal Fixation (ORIF) procedure.

Methods: The study was conducted using a pre-experimental design with a single-group pretest-posttest approach to 53 post-ORIF patients with lower extremity fractures treated in the inpatient ward of Sragen Regional General Hospital, Surakarta. Instruments used included the Barthel Index to assess functional status, the Fall Efficacy Scale, and a clinical observation sheet to evaluate physical ability. Data were analysed using the Wilcoxon test.

Results: Data showed an improvement in balance function, coordination, and overall functional status in post-ORIF patients with lower extremity fractures after receiving the integrated activity training intervention. The Wilcoxon test showed a p-value of 0.001, indicating a statistically significant effect.

Conclusion: The study demonstrates that an integrated physical exercise program combined with pain management and fall efficacy enhancement has a significant impact on improving balance, coordination, and functional status in patients recovering from fractures.

Keywords: fall efficacy, fracture, functional status, pain management

INTRODUCTION

Traffic accidents remain the leading cause of increased incidence of bone fractures, particularly in the lower extremities. One of the most common types of fractures is femoral fractures, which often require surgical intervention due to the complexity of the injury and the high risk of postoperative pain.(Fujikawa et al., 2022). Previous studies have shown that data presented indicate that femoral fractures rank highest in Indonesia, accounting for 39% of cases, followed by humerus fractures (15%) and tibia-fibula fractures (11%). The majority of femoral fractures result from motor vehicle accidents involving cars, motorcycles, or recreational vehicles (62.6%), while the remainder are caused by falls (37.3%). Most cases occur in males (63.8%) (Abedi et al., 2025). Therapeutic approaches to fractures are generally classified into two categories: conservative and surgical. Conservative treatments include non-operative methods such as cast application, splinting, skin traction, skeletal traction, and manual manipulation to realign bones to their anatomical position. In contrast, surgical interventions involve procedures such as Open Reduction and Internal Fixation (ORIF) and Open Reduction and External Fixation (OREF) (Howell et al., 2023).

Following orthopaedic surgery, patients often face multiple challenges during the recovery process, particularly postoperative pain, impaired tissue perfusion, limited mobility, and psychological issues related to body image and participation in daily activities (Gao et al., 2024). Severe pain can limit mobility, especially when positions like sitting increase pressure on the fracture site, ultimately contributing to a decline in functional status (Asplin et al., 2017). This decline is especially evident in basic activities such as bathing, eating, dressing, or toileting—even when performed in bed. Therefore, a structured and integrated physical activity intervention is essential to accelerate physical function recovery. This intervention includes a series of body movements and postures carried out systematically and designed to address physical impairments, prevent further limitations, and restore overall physical capacity (Bolovan et al., 2023). However, the training process is often disrupted by pain, which may trigger fear or anxiety in patients when attempting to move. Hence, this intervention must also consider pain management strategies and fall efficacy, or the patient's confidence in avoiding falls (Chevalley & Rizzoli, 2022).

This study aims to evaluate the effect of an integrated physical activity intervention combined with pain management and fall efficacy enhancement on the functional status of patients following lower extremity fracture surgery using the Open Reduction and Internal Fixation (ORIF) procedure. This intervention approach is expected to improve patients' balance, coordination, and independence in performing daily activities. Internal data from Sragen Hospital indicate that, between July and September 2024, a total of 156 fracture cases were recorded, with 87 patients undergoing surgical procedures (both ORIF and OREF). Of these, 53 patients specifically underwent ORIF on the lower extremities. However, rehabilitation practices at the hospital have thus far been limited to conventional physiotherapy interventions, without comprehensive integration of pain management and fall efficacy approaches—components that are crucial for optimizing functional recovery in post-surgical patients.

METHODS

This study employed a quantitative approach with a pre-experimental research design, specifically using a one-group pretest-posttest design. In this design, the functional status of the subject group was observed prior to the intervention—an integrated activity therapy combined with pain management and fall efficacy enhancement—and then observed again after the intervention was administered.

The study population consisted of all post-ORIF patients with lower extremity fractures who were hospitalized in the inpatient ward of Sragen Hospital Surakarta from July to September 2024, totaling 53 patients. The research instruments used for data collection included: an informed consent form, Barthel Index to assess functional status, the Fall Efficacy Scale, and an observation sheet to record functional status before and after the implementation of the integrated exercise program with pain management and fall efficacy components (Faidah et al., 2020). The Barthel Index was used in this study to assess the functional status of patients in performing basic daily activities such as eating, bathing, dressing, transferring, and controlling bladder and bowel functions. It consists of 10 items with a total score ranging from 0 to 100, where higher scores indicate greater levels of independence. This instrument provides a comprehensive evaluation of a patient's ability to function in everyday life and is widely used in rehabilitation settings.

The Fall Efficacy Scale (FES) was employed to measure the patient's level of confidence or fear related to performing activities without falling. This scale assesses the individual's perception of their risk of falling during various daily tasks. It is expressed on an ordinal scale and helps to identify psychological barriers that may affect mobility and overall rehabilitation outcomes. In addition, a clinical observation sheet was utilised by the researchers to systematically record the physical abilities and changes in the functional status of patients both before and after the intervention. This observational tool served to complement the self-reported instruments by capturing objective data on the patients' physical performance during the study period. To ensure the accuracy and appropriateness of the research instrument used in this study, a validity test was conducted. Content validity was assessed by consulting a panel of experts in orthopaedic rehabilitation and physiotherapy to evaluate the relevance, clarity, and comprehensiveness of the questionnaire items. The experts' feedback was used to revise and refine the instrument to ensure it accurately measures balance and coordination outcomes in post-fracture surgery patients.

A reliability test was carried out to examine the internal consistency and stability of the instrument. The Cronbach's Alpha coefficient was calculated to assess the consistency of responses across items, with a value of 0.89, which is thus acceptable. Additionally, a test-retest procedure was applied to determine the stability of the measurements over time, ensuring that the tool yields consistent results when used under similar conditions. For bivariate analysis, the Wilcoxon test was employed. The Wilcoxon test was chosen because the data used in this study were measured on an ordinal scale, which is a type of categorical data.

RESULT

Before analysing the effects of integrated physical exercise on balance and coordination in patients following fracture surgery, it is important to describe the basic demographic characteristics of the study participants. The following tables present the distribution of participants based on gender and age, which are essential for understanding the background and potential variability within the study population.

Table 1. Age and Gender

Age Group	Male	Female	Total	Percentage (%)
Adults (26–45)	5	6	11	37.9%
Elderly (46–65)	4	5	9	31.0%
Seniors (>65)	5	4	9	31.0%
Total	14	15	29	100.0%

According to table 1, among the 29 respondents studied, the majority were adults aged 25 to 45 years, with 11 respondents representing 41.2%. Additionally, the data shows that a majority of the respondents were female, comprising 15 individuals or 52.9%.

The table below presents the effectiveness of fall prevention measures, as well as the functional status of individuals before and after engagement in activities.

Table 2. Frequency Distribution Based on Fall Efficacy

Fall Efficacy	Frequency	Percentage (%)
High	29	100
Medium	0	0
Low	0	0
Total	29	100%

Based on table 3, it can be seen that of the 29 respondents studied, all respondents (100%) have high fall efficacy.

Table below presents the frequency distribution of respondents' functional status before receiving integrated activity training.

Table 3. Frequency Distribution Based on Balance Status Before Integrated Activity Training

Functional status	Frequency	Percentage (%)
Moderat dependence	14	47,1
Heavy dependence	15	52,9
Total	29	100%

Based on table 3, it can be seen that of the 29 respondents studied, the most were heavy dependent with 15 respondents (52.9%).

Table 4. Frequency Distribution Based on Balance Status After Integrated Activity Training

Functional Status	Frequency	Percentage (%)
Moderate Defence	18	58,8
Heavy Defence	11	41,2
Total	29	100%

Based on table 4, it can be seen that of the 17 respondents studied, the most were moderately dependent, namely 18 respondents (58.8%).

Differences in functional status of post-ORIF lower extremity fracture patients before and after integrated training with pain management and fall efficacy were carried out using the Wilcoxon test.

Table 5. Differences in Functional Status Before and After Integrated Activity Training

	Frequency	<i>p</i>
Functional Status before activity	29	0,005
Functional Status after activity	29	

From the table above, it can be seen that the results of the Wilcoxon test analysis obtained a *p* value of 0.005 ($p < 0.05$), which shows that there is an effect of integrated activity training with pain management and fall efficacy on the functional status of patients with post-ORIF lower extremity fractures. The age group that experiences the most fractures is adulthood (25-45 years). This is in accordance with research conducted by Purnamasari (2014), which stated that the age group that experiences the most fractures is 21-45 years. Research conducted (Ersoy et al., 2024) also found that the most fractures occurred in early adulthood (18-30 years). Patients with an age range of 18-30 years most often experience femur fractures due to traffic accidents because this age is a productive age, and usually at that age, most have high enough mobility to do outdoor activities (Sornette & Sornette, 2025). Fractures tend to occur at ages under 45 years because at that age they are often related to sports, work, or which now often occur due to injuries caused by motor vehicle accidents.(Li et al., 2023).

DISCUSSION

The comparison of male and female genders is not much different, namely only a difference of 1 respondent. According to previous study, male respondents had more fractures, namely 83 people (71.5%) (Yu et al., 2025). Men are more active and do more activities than women. Activities outside the home for work have a higher risk of injury. Meanwhile, according to a study in 2019, the largest number of fracture patients occurred in female respondents, namely 19 respondents (59%) (Wu et al., 2019). In women, fractures are more often caused by osteoporosis. Women are at higher risk of

osteoporosis because women have lower bone mass and experience faster bone loss. Women are more susceptible to osteoporosis because hormonal changes occur that can drastically reduce the body's ability to absorb calcium (Huang et al., 2023).

All respondents have high fall efficacy, so they need high attention and motivation. Fall efficacy is the level of fear of someone falling while doing an activity (Agusrianto & Rantesigi, 2020). The fear of falling in someone will affect someone in their activities, which can affect the patient's functional status. This is in accordance with research in 2025, which found that 58% (33 respondents) of hip fracture patients had high fall efficacy (Sornette & Sornette, 2025). Annette explained that fall efficacy can affect recovery after hip fracture and is a limiting factor in the functional status of elderly patients. Fear of falling must be overcome, and in future research, screening for fear of falling in hospitals is useful for patient rehabilitation. Fall efficacy is determined by several personal components consisting of the function of will, feelings, values, and interests (Ersoy et al., 2024). Research conducted by Peterson and colleagues stated that fall efficacy is based on personal acceptance of the disease, acceptance of changes in capacity, self-control ability, ability to learn and do, alertness, and personal responsibility (Pratiwi, 2023). The increase in the basic components of fall efficacy will increase along with the improvement in post-operative conditions of lower extremity fractures, so that it will increase efficacy for independence (Abedi et al., 2025).

The functional status of patients who experience severe dependence is higher, namely 15 respondents. This is in accordance with research conducted in 2023, namely the functional status of post-operative extremity fracture patients from 47 respondents, which stated that 48.94% had moderate dependence, and 38.30% had severe dependence. (Howell et al., 2023). According to a study in 2023, post-operative functional status can be influenced by age factors (Bolovan et al., 2023). Research on respondents aged 60-89 years indicates that age significantly influences functional status (Fujikawa et al., 2022).

After integrated training, the functional status of patients became more moderately dependent, namely 18 respondents. This is in accordance with research conducted by (Chevalley & Rizzoli, 2022). This states that pain is the most influential factor in the functional status of post-ORIF extremity fracture patients after controlling for fall efficacy and type of fracture (Fauziah et al., 2021). Pain inhibits the ability to carry out activities that require mobilisation, which results in pressure on the fracture area. The sitting position tends to cause pressure on the fracture area, increasing the intensity of pain (Li et al., 2023). Research conducted (Gao et al., 2024) stated that fall efficacy has a significant effect on the functional status of patients with post-operative lower extremity fractures. Low fall efficacy means that respondents are confident that they can carry out basic daily activities without falling even though the respondent has a poor functional status (Soukkio et al., 2022).

Based on the results of the Wilcoxon test analysis, a p-value of 0.005 was obtained. From these results, it can be seen that there is an effect of integrated activity exercise with pain management and fall efficacy on the functional status of post-ORIF lower extremity fracture patients. This is in accordance with research conducted by (Yu et

al., 2025) The factors that influence the functional status of post-ORIF patients with extremity fractures include age, length of post-operative care, type of fracture, pain, fatigue, motivation, fall efficacy, and family support, with pain being the most influential factor. Tanziela (2022) stated that there was a significant relationship between pain intensity and functional status in grade II knee osteoarthritis patients. This shows that pain can affect the ability to perform daily activities, which are components of functional status. In post-ORIF surgery patients, patients always feel pain caused by the break in tissue continuity caused by fractures or surgical wounds. A person's feeling of pain will cause a person's fear of doing daily activities, which will disrupt the patient's functional status. (Widiastuti et al., 2023). Many patients are afraid to mobilise because they feel pain, which also triggers a fear of falling when doing activities, which will hinder the patient's functional status. After integrated therapy with pain management and motivation about fall efficacy, patients understand more about how to control pain and also reduce fall efficacy (Syafitri et al., 2025)

CONCLUSION.

It can be concluded that this structured and holistic exercise approach is effective in enhancing balance ability, movement coordination, and patients' independence in performing daily activities. The intervention also proves beneficial in addressing psychological barriers such as fear of pain and anxiety about falling, which often hinder the postoperative rehabilitation process.

RECOMMENDATIONS

Hospitals should consider implementing structured rehabilitation protocols that combine physical exercise, pain management, and psychological support. It is essential for physiotherapists, orthopedic teams, and mental health professionals to collaborate in order to optimize patient outcomes following Open Reduction and Internal Fixation (ORIF) procedures. Future studies should aim to use larger and more diverse sample sizes, employ randomized controlled trial designs, and include long-term follow-up to assess the lasting effects of integrated physical exercise, pain management, and fall efficacy on post-fracture recovery.

REFERENCES

- Abedi, A., Malmirian, M., & Khan, S. S. (2025). Cross-Modal Video to Body-Joints Augmentation for Rehabilitation Exercise Quality Assessment. *Communications in Computer and Information Science*, 2136 CCIS, 320–327. https://doi.org/10.1007/978-3-031-74640-6_24
- Agusrianto, & Rantesigi, N. (2020). Penerapan Latihan Range of Motion (ROM) Pasif terhadap Peningkatan Kekuatan Otot Ekstremitas pada Pasien dengan Kasus Stroke Application of Passive Range of Motion (ROM) Exercises to Increase the Strength of the Limb Muscles in Patients with Stroke Cases. *Jurnal Ilmiah Kesehatan (JIKA)*, 2(2), 61–66.
- Asplin, G., Carlsson, G., Zidén, L., & Kjellby-Wendt, G. (2017). Early coordinated rehabilitation in acute phase after hip fracture - A model for increased patient participation. *BMC Geriatrics*, 17(1), 1–12. <https://doi.org/10.1186/s12877-017->

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- Bolovan, A. D., Onofrei, R. R., Hoge, G. B., Abu-Awwad, A., Lazarescu, E. A., Abu-Awwad, S. A., Tapardea, A. R., Suba, M. I., & Amaricai, E. C. (2023). Comparison between Exercise Program–Foot Orthoses Treatment and Exercise Program Alone after Pilon Fracture Surgery: Study Protocol for a Randomized Controlled Trial. *Life*, 13(11), 1–14. <https://doi.org/10.3390/life13112187>
- Chevalley, T., & Rizzoli, R. (2022). Acquisition of peak bone mass. *Best Practice and Research: Clinical Endocrinology and Metabolism*, 36(2), 1–15. <https://doi.org/10.1016/j.beem.2022.101616>
- Ersoy, T., Kaya, P., Hocaoglu, E., & Unal, R. (2024). I-BaR: integrated balance rehabilitation framework. *Frontiers in Neurorobotics*, 18, 1–37. <https://doi.org/10.3389/fnbot.2024.1401931>
- Faidah, N., Kuswardhani, T., & Artawan E.P, I. W. G. (2020). Pengaruh Latihan Keseimbangan Terhadap Keseimbangan Tubuh Dan Risiko Jatuh Lansia. *Jurnal Kesehatan*, 11(2), 100. <https://doi.org/10.35730/jk.v11i2.428>
- Fauziah, E., Zulfah, K., & Oktaviani, Y. E. (2021). Penatalaksanaan Fisioterapi untuk Meningkatkan Keseimbangan Dinamis Lansia dengan Teknik Core Stability Exercise dan Tandem Walking Exercise. *FISIO MU: Physiotherapy Evidences*, 3(1), 16–22. <https://doi.org/10.23917/fisiomu.v3i1.14126>
- Fujikawa, T., Takahashi, S., Shinohara, N., Mashima, N., Koda, M., Takahashi, H., Yasunaga, Y., Sankai, Y., Yamazaki, M., & Miura, K. (2022). Early Postoperative Rehabilitation Using the Hybrid Assistive Limb (HAL) Lumbar Type in Patients With Hip Fracture: A Pilot Study. *Cureus*, 14(2). <https://doi.org/10.7759/cureus.22484>
- Gao, Y., Zhong, F., Zhan, X., Bao, Y., & Zhu, X. (2024). Postoperative rehabilitation exercise experiences of geriatric patients with femoral neck fractures based on the perspective of medical staff: a qualitative study. *BMC Geriatrics*, 24(1). <https://doi.org/10.1186/s12877-024-05266-w>
- Howell, D. F., Malmgren Fänge, A., Rogmark, C., & Ekvall Hansson, E. (2023). Rehabilitation Outcomes Following Hip Fracture of Home-Based Exercise Interventions Using a Wearable Device—A Randomized Controlled Pilot and Feasibility Study. *International Journal of Environmental Research and Public Health*, 20(4). <https://doi.org/10.3390/ijerph20043107>
- Huang, M. Z., Rogers, M. W., Pizac, D., Gruber-Baldini, A. L., Orwig, D., Hochberg, M. C., Beamer, B. A., Creath, R. A., Savin, D. N., Conroy, V. M., Mangione, K. K., Craik, R., Zhang, L. Q., & Magaziner, J. (2023). Effect of Multicomponent Home-Based Training on Gait and Muscle Strength in Older Adults After Hip Fracture Surgery: A Single Site Randomized Trial. *Archives of Physical Medicine and Rehabilitation*, 104(2), 169–178. <https://doi.org/10.1016/j.apmr.2022.08.974>
- Li, X., Chen, W., Chen, Q., Li, F., Chen, C., Li, P., Li, F., Guo, S., Chen, P., Yuan, W., Liu, D., Wang, S., & Hu, Z. (2023). Effects of resistance and balance exercises for athletic ability and quality of life in people with osteoporotic vertebral fracture: Systematic review and meta-analysis of randomized control trials. *Frontiers in Medicine*, 10(March). <https://doi.org/10.3389/fmed.2023.1135063>
- Pratiwi. (2023). Program Fisioterapi Pada Kondisi Pasca Operasi Fraktur Radius Ulna : Case Report. *Journal of Physiotherapy*, 2(April), 216–223.
- Sornette, P.-E., & Sornette, D. (2025). *Harnessing the “Reactive Falling Effect” for rehabilitation and performance boosting*. <http://arxiv.org/abs/2506.13959>
- Soukkio, P. K., Suikkanen, S. A., Kukkonen-Harjula, K. T., Kautiainen, H., Hupli, M. T., Aartolahti, E. M., Kääriä, S. M., Pitkälä, K. H., & Sipilä, S. (2022). Effects of a 12-

- month home-based exercise program on functioning after hip fracture – Secondary analyses of an RCT. *Journal of the American Geriatrics Society*, 70(9), 2561–2570. <https://doi.org/10.1111/jgs.17824>
- Syafitri, P. K., Hayuningrum, C. F., Apriliani, T., & Utomo, D. H. (2025). Penatalaksanaan fisioterapi pada kasus Post ORIF Fraktur 1/3 Proximal Tibia Dextra dengan menggunakan terapi latihan di RS Hermina Daan Mogot. *Indonesian Journal of Health Science*, 5(1), 101–109. <https://doi.org/10.54957/ijhs.v5i1.1342>
- Widiastuti, A., Rahmasari, I., Budiati, D., Ermawati Ulkhasanah, M., & Yuli Kartikasari, A. (2023). the Effect of Early Mobilization Exercise on the Level of Independence on Patients After Post Operative Fracture Femur. *Proceeding of International Conference on Science, Health, And Technology*, 309–315. <https://doi.org/10.47701/icohetech.v4i1.3408>
- Wu, J. Q., Mao, L. B., & Wu, J. (2019). Efficacy of balance training for hip fracture patients: A meta-analysis of randomized controlled trials. *Journal of Orthopaedic Surgery and Research*, 14(1), 1–11. <https://doi.org/10.1186/s13018-019-1125-x>
- Yu, M., Zhou, P., Che, Y., & Luo, Y. (2025). The efficacy of exercise prescription in patients with osteoporotic fractures: a systematic review and meta-analysis. *Journal of Orthopaedic Surgery and Research*, 20(1), 250. <https://doi.org/10.1186/s13018-025-05636-z>