Jurnal Ners Volume 9 Nomor 3 Tahun 2025 Halaman 4837 - 4845
JURNAL NERS
Research & Learning in Nursing Science
http://journal.universitaspahlawan.ac.id/index.php/ners

EARLY MOBILIZATION WITH DIGITAL-BASED ISOMETRIC EXERCISE INTERVENTION: IMPACT ON PAIN AND MUSCLE STRENGTH POST-ORIF UPPER EXTREMITY

Valentino Febryandy[1], Dhea Natashia[2*], Dewi Gayatri[3], Wati Jumaiyah[4] ,Winda Yuniarsih[5]
[1]Master's Program in Nursing, Muhammadiyah University of Jakarta
[2,4]Faculty of Nursing Science, Muhammadiyah University of Jakarta
[3]Faculty of Nursing Science, University of Indonesia
[5]Fatmawati General Hospital Jakarta
natashia-dhea@umj.ac.id

Abstract

Background Fracture is a condition of partial or complete bone discontinuity. Upper extremity fractures can be caused by direct trauma (such as accidents) or indirect trauma (such as excessive pressure). Fracture management is performed through surgery such as Open Reduction Internal Fixation (ORIF), which can cause pain and muscle stiffness. Early mobilization with isometric exercises is needed to prevent these problems. Objective This study aims to determine the effect of digital-based Isometric Exercise on pain levels and muscle strength in patients post-ORIF upper extremity fracture. Methods The study used a Quasi-Experimental design with a Pretest-Posttest Control Group approach, involving 34 respondents divided into two groups. Muscle strength was measured using a Hand Grip Dynamometer, while pain was measured using the Brief Pain Inventory Short Form (BPI-SF). Isometric exercise intervention was performed 24 hours after surgery, twice daily with a duration of 35 minutes per intervention. Results The study showed a more significant increase in muscle strength in the intervention group compared to the control group with a Mean difference increasing to 4.23 (95% CI: 3.28-5.18), t=9.062, df=32, p=0.000. Pain levels also decreased more in the intervention group with a Mean difference of 1.81 (SD=0.866), 95% CI: 1.51-2.11, t=12.2, df=33, p=0.000. Conclusion: Isometric exercise is effective as early mobilization to reduce pain and increase muscle strength in ORIF upper extremity fracture patients.

Keywords: Digital Intervention, Upper Extremity Fracture, Isometric Exercise, Muscle Strength, Pain

✉ Corresponding author :
Address : Cempaka Putih, Jakarta Timur
Emai : natashia-dhea@umj.ac.id
Phone : 08111130689

INTRODUCTION

Fracture is the disruption of bone continuity either partially or completely that can occur due to direct or indirect trauma (Kerschan-Schindl et al., 2024). Upper extremity fractures specifically include anatomical areas from the upper arm, elbow, forearm, to the wrist, which is one type of fracture with a fairly high incidence rate (Monticone et al., 2021). Data from the Basic Health Research (Riskesdas) in 2018 showed that the prevalence of fractures in the Indonesian population aged ≥15 years reached 1.5%, with significant cases found in East Jakarta and Bekasi Regency.

Upper extremity fracture conditions result in various serious clinical impacts, especially severe pain that can significantly interfere with patients' quality of life (Diyanto et al., 2023), accompanied by muscle weakness that can affect extremity function in performing daily activities. Management of upper extremity fractures is generally performed through Open Reduction and Internal Fixation (ORIF) procedures, which is a surgical intervention aimed at stabilizing bone fragments using internal implants such as plates and screws or intramedullary nails (Rustikarini et al., 2023).

The post-ORIF surgical phase is a critical period that requires appropriate management to optimize the healing process. Early mobilization is essential to prevent complications such as muscle contractures, joint stiffness, and muscle atrophy due to prolonged immobilization (Gatty et al., 2022). In this context, isometric exercise with a digital intervention approach becomes an attractive therapeutic option because it is a form of exercise that can be performed without excessive joint movement, yet still provides effective muscle contractions to improve blood circulation and reduce pain intensity (Farzad et al., 2021).

Various studies have shown significant benefits of isometric exercise in reducing pain and increasing muscle strength in various musculoskeletal conditions (Berg et al., 2021). Specifically, Fan et al. (2023) in their research proved the effectiveness of isometric exercise in reducing pain levels and increasing muscle strength in post-orthopedic surgery patients. The mechanism of isometric exercise in increasing muscle strength occurs through stimulation of optimal neuromuscular responses and increased blood flow to the injured area, thereby accelerating tissue healing processes (Worraphan et al., 2020; Cioroiu, 2023).

Although scientific evidence shows the effectiveness of isometric exercise, implementation of this intervention with a digital approach is still rarely performed in Indonesian healthcare facilities. This gap between evidence-based practice and actual clinical practice indicates the need for research to explore the application of digital-based isometric exercise in the local context. Therefore, this study aims to determine the effect of digital-based isometric exercise on reducing pain intensity and increasing muscle strength in upper extremity fracture patients post-ORIF intervention.

METHODS

This study used a quasi-experimental design with a control group pretest-posttest design approach. Participants were divided into two groups: the experimental group that received digital-based isometric exercise intervention in the form of videos and the control group that received standard therapy. This research was conducted at Bekasi Regency Regional Hospital with the research implementation period from November 2024 to January 2025. The population in this study consisted of patients aged over 18 years who experienced upper extremity fractures, namely humerus, radius, and ulna, with a sample according to inclusion criteria totaling 34 respondents.

Purposive sampling was then conducted to obtain 34 respondents according to G-Power calculations, followed by purposive sampling technique where groups were divided into control and intervention groups. The control group was studied first with 17 people, followed by the intervention group with 17 people, therefore the total sample size was 34 people. When the research process began, explanations and informed consent were provided, and the pre-test was conducted 24 hours post-ORIF surgery. After that, respondents were explained about the exercises they would undergo and were guided during the exercise process. Subsequently, respondents were given videos containing isometric exercises to be performed twice daily during the hospitalization period. The second measurement was conducted at the end of the hospital care period, after which patients would continue exercises at home with video instructions provided by the researcher. The third measurement was conducted when patients had follow-up visits at the outpatient clinic.

Univariate analysis used mean, SD, min-max value distributions for age characteristics, nutritional status, muscle strength, and pain scale. For categorical characteristics, value distributions were used for gender, education, occupation, fracture type, and analgesic use. Bivariate analysis used Independent T-Test, t-test, effect size, and this research has received approval from the ethics committee of the Faculty of Nursing Science, Muhammadiyah University of Jakarta with No. 1699/F.9-UMJ/XI/2024.

RESULT AND DISCUSSION

Respondent Characteristics

Table 1. Distribution of respondent characteristics based on age, nutritional status (BMI), pre muscle strength, pre pain severity and pre pain interference.

Variabel	Group	n	Mean	Min - Max	SD	t	*p Value*
Age	Control	17	42,00	27-57	8,573	-0,910	0,403
	Intervention	17	38,88	18-61	11,230		
Nutrition Status (BMI)	Control	17	21.31	17.30-33.20	2.72	0,429	0,671
	Intervention	17	21,82	18.00-31.70	3.21		
Muscle strenght Pre	Control	17	14,82	13-17	1,510	0,000	1,000
	Intervention	17	14,82	12-18	1,131		
Pain Severity Pre	Control	17	5,07	5,75-6,75	0,654	-6.678	0,000
	Intervention	17	6,26	3,75-5,75	0,336		
Pain Interference Pre	Control	17	5,37	6,00-7,14	0,752	-5.685	0,000
	Intervention	17	6,62	4,14-6,14	0,497		

The results above show that the control group (17 participants) had a mean age of 42 years (range 27-57, SD = 8.573), while the intervention group (17 participants) had a mean age of 38.88 years (range 18-61, SD = 11.230). The t-value = -0.910 and p = 0.403 indicate no significant age difference between groups.

The mean Body Mass Index (BMI) of the control group was 21.31 (SD = 2.72) and the intervention group was 21.82 (SD = 3.21), with t = 0.429 and p = 0.671, indicating similar nutritional status.

For pre-test muscle strength, both groups had identical means of 14.82, with t = 0.000 and p = 1.000, showing no significant difference. For the pain severity variable, the control group had a mean of 5.07 (SD = 0.654) and the intervention group 6.26 (SD = 0.336), with t = -6.678 and p = 0.000, showing a significant difference. For pain interference, the control group had a mean of 5.37 (SD = 0.752) and the intervention group 6.62 (SD = 0.497), with t = -5.685 and p = 0.000, also showing a significant difference.

Distribution of Characteristics Based on Gender, Occupation, Education, Fracture Type, Analgesics, and Nutrition (BMI).

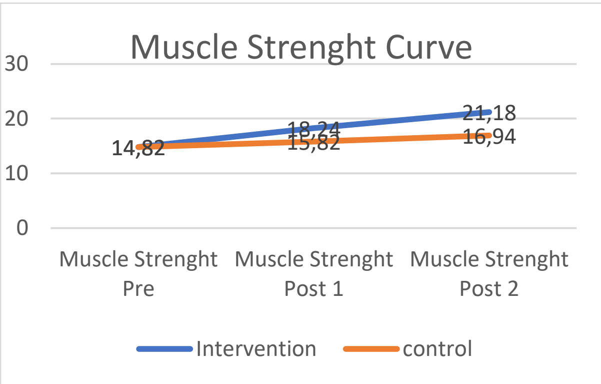
Table 2. Distribution of respondent characteristics based on gender, occupation, education, type of fracture, analgesics and nutrition (BMI).

No	Variabel	Group		Total n(%)	X^2 *Chi Square*	*P Value*
		Control n(%)	Intervention n(%)			
1	Gender					
	Man	8(23,1)	11(76,9)	19(53,6)	1,074	0,300
	Woman	9(66,7)	6 (33,3)	15(46,4)		
2	Education					
	High	12(35,2)	13(38,2)	25(73,5)	0,151	1,000
	Low	5(14,7)	4(11,7)	9 (26,4)		
3	Job					
	Work	13(71,4)	13(28,6)	26(76,6)	0,000	1.000
	Does not Work	4 (35,7)	4(64,3)	8(23,4)		
4	Type of Fracture					
	Humerus	7 (20,59)	8 (23,53)	15 (44,12)	0.144	0.931
	Radius	7 (20,59)	6 (17,6)	13 (38,24)		
	Ulna	3 (8,82)	3 (8,82)	6 (17,6)		
5	Analgetic					
	Paracetamol	3 (8,82)	4 (11,76)	7 (20,59)	0,602	0,740
	Tramadol	6 (17,65)	4 (11,76)	10 (29,41)		
	Keterolac	8(23,53)	9 (26,47)	17 (50)		

The analysis results show that there is no significant relationship between gender and the

intervention group, with a Chi-Square value of 1.074 and p-value of 0.300.
For education level, there were 25 respondents (73.5%) with higher education, with 12 in the control group and 13 in the intervention group, and 9 respondents (26.4%) with lower education. The Chi-Square test showed $X^2 = 0.151$ and p-value = 1.000, indicating a balanced distribution of education between both groups.
Analysis of fracture type showed Chi-Square 0.144 and p-value 0.931, indicating no significant relationship with the intervention group. Additionally, for analgesic use, the Chi-Square value of 0.602 and p-value of 0.740 also showed no significant difference between the two groups.

Average muscle strength and pain level overview

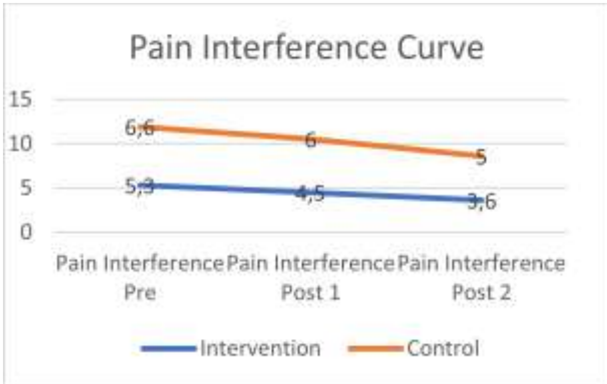


Picture 1. Average muscle increase before and after Isometric Exercise in each group

Based on the results of the analysis of muscle strength measurements carried out three times, there was a difference in improvement between the intervention group and the control group. In the first measurement (baseline), both groups had the same average value of 14.82. This indicates an equivalent initial condition between the two groups. These results indicate that the digital-based isometric exercise intervention program given to the intervention group had a more effective impact on increasing muscle strength compared to standard care given to the control group.

Picture 2 . Average reduction in pain sevarate and interference pain before and after isometric exercise in each group

Based on the results of the average pain scale measured by the Brief Pain Inventory Short Form (BPI-SF) in the intervention and control groups, a significant decrease in the severity and interference due to pain was seen. In the initial measurement, the intervention group showed an average pain severity value of 5.07, while the control group was higher at 6.26. After the intervention, the pain severity value in the intervention group decreased to 3.25, while the control group only decreased to 4.2.



Picture 3. Average reduction in pain interference and interference pain before and after isometric exercise in each group

The same thing was seen in the measurement of pain interference; the intervention group initially had an average of 5.3, while the control group had an average of 6.6. At the end of the measurement, the intervention group recorded a decrease to 3.6, while the control group decreased to 5. These results indicate that the intervention given was effective in reducing both the severity and interference of pain, compared to the control group which showed less decrease Difference.

The effectiveness of isometric exercise on muscle strength and pain levels.

Table 3. Difference in Average Muscle Strength Pre-Post

Variabel	Group	Mean	SD	MD(95%CI)	t	df	P
Muscle Strenght Pre	Intervention	14,82	1,510	0,00(-0.93;0.93)	0,000	32	1,000
	Control	14,82	1,131				
Muscle Strenght Post 1	Intervention	18,24	1,562	2,41 (1,45;3,36)	5,155	32	0,000
	Control	15,82	1,131				
Muscle Strenght Pre	Intervention	14,82	1,510	0,00(-0.93;0.93)	0,000	32	1,000
	Control	14,82	1,131				
Muscle Strenght Post 2	Intervention	21,18	1,510	4,23(3.28;5,18)	9,062	32	0,000
	Control	16,94	1,197				

At pre-test, both groups had the same mean value (14.82; intervention SD=1.510; control SD=1.131) with a mean difference of 0.000 and p=1.000 (t=0.000, df=32), showing equivalent baseline. At Post 1, there was a significant difference (p=0.000). The intervention group achieved a mean of 18.24 (SD=1.562), while the control group had 15.82 (SD=1.131), with a mean difference of 2.412 (t=5.155, df=32). At the final post-test, the difference became even more significant (p=0.000, t=9.062, df=32). The intervention group achieved a mean of 21.18 (SD=1.510), the control group 16.94 (SD=1.197), with a mean difference of 4.235. This proves that the intervention program significantly improved muscle strength compared to standard care.

Table 4 . The average difference in muscle strength and the difference

Variabel	Group	Mean	SD	MD (95% CI)	t	df	P
Muscle Strenght Pre	Intervensi	14,82	1,510	0,00 (-0,93; 0,93)	0,000	32	1,000
	Kontrol	14,82	1,131				
Muscle Strenght Post 1	Intervensi	18,24	1,562	2,41 (1,45; 3,36)	5,155	32	0,000
	Kontrol	15,82	1,131				
Muscle Strenght Post 2	Intervensi	21,18	1,510	4,23 (3,28; 5,18)	9,062	32	0,000
	Kontrol	16,94	1,197				
Difference (Post 2 - Pre)	Intervensi	6,35	0,701	4,23 (3,85; 4,61)	9,062	32	0,000
	Kontrol	2,12	0,662*				

Based on the data in the table, the analysis results show several important findings related to muscle strength. At the initial measurement (pre), there was no significant difference between the intervention and control groups with the same mean value (14.82) and p-value 1.000, indicating that both groups had equivalent baseline conditions.

After the intervention, significant differences began to appear in the first measurement (Post 1). The intervention group showed an increase in mean to 18.24 compared to the control group which was only 15.82, with a mean difference of 2.41 (95% CI: 1.45-3.36) and p-value 0.000 indicating a statistically very significant difference.

The difference became stronger in the second measurement (Post 2), where the intervention group reached a mean of 21.18 while the control group was 16.94. The mean difference increased to 4.23 (95% CI: 3.28-5.18) with p-value 0.000, showing an increasingly strong intervention effect over time.

The difference analysis (Post 2 - Pre) showed that the intervention group experienced an increase in muscle strength of 6.35 points, much higher compared to the control group which was only 2.12 points. The mean difference of 4.23 (95% CI: 3.85-4.61) with p-value 0.000 confirms that the given intervention was significantly more effective in increasing muscle strength compared to the control group.

Table 5 . The difference in average Pain Severity and the difference

Variabel	Group	Mean	SD	MD(95%CI)	t	df	P
Pain Severity Pre	Intervention	5,0735	.65410	-1.19(-1.55;-0,82)	-6.678	32	.000
	Control	6,2647	.33623				
Pain Severity Post 1	Intervention	3,9853	.36944	-1.20(-1,43;-0,97)	10.826	32	.000
	Control	5,1912	.27285				
Pain Severity Post 2	Intervention	3,2500	.37500	-.98(-1.23;-0,74)	-8.193	32	.000
	Control	4,2353	.32441				
Post	Intervention	3,2500	.37500	-.98(-1.23;-0,74)	-8.193	32	0.000
	Control	4,2353	.32441				
Difference	Pain Severity	1,81	0,866	(1.51;2.11)	12.2	33	0,000

The results of the independent t-test analysis for pain measurement with BPI-SF showed significant differences between the intervention and control groups. For Pain Severity, in the pre-test there was a significant difference (p=0.000) between the intervention group (M=5.07, SD=0.65) and control group (M=6.26, SD=0.34) with a mean difference of -1.19 (t=-6.678, df=32). In the mid-test, the intervention group (M=3.99, SD=0.37) showed a greater decrease compared to the control group (M=5.19, SD=0.27) with a mean difference of -1.21 (t=-10.826, df=32, p=0.000). In the post-test, the intervention group (M=3.25, SD=0.38) continued to show better results compared to the control group (M=4.24, SD=0.32) with a mean difference of -0.99 (t=-8.193, df=32, p=0.000). The Pain Severity difference analysis showed a mean difference of 1.81 (SD=0.866), 95% CI: 1.51-2.11, t=12.2, df=33, p=0.000, proving that the intervention was effective in reducing pain levels in the treatment group.

Table 6 . The average difference of Pain Interference and the difference

Variabel	Group	Mean	SD	MD(95%CI)	t	df	P
Pain Intereference Pre	Intervention	5,3782	.75245	-1.24(-1,69;-0,79)	-5.685	32	.0(
	Control	6,6218	.49729				
Pain Intereference Post 1	Intervention	4,5294	.30625	-1.50(-1.58;-1.31)	15.947	32	.0(
	Control	6,0336	.23974				
Pain Intereference Post 2	Intervention	3,6471	.22084	-1.40(-1.58;-1,21)	15.439	32	.0(
	Control	5,0504	.30280				
Post	Intervention	3,6471	.22084	-1.40(-1.58;-1,21)	15.439	32	0.(
	Control	5,0504	.30280				
Difference	Pain Interference	2,69	1,11	(2,30;3,08)	14.08	33	0,(

In the Pain Interference dimension, there were significant differences in all measurements. In the pre-test, the intervention group (M=5.38, SD=0.75) differed significantly from the control group (M=6.62, SD=0.50), with a mean difference of -1.24 (t=-5.685, df=32, p=0.000). In the mid-test, the intervention group (M=4.53, SD=0.31) showed a greater decrease compared to the control group (M=6.03, SD=0.24), with a mean difference of -1.50 (t=-15.947, df=32, p=0.000). In the post-test, the intervention group (M=3.65, SD=0.22) continued to show better results compared to the control group (M=5.05, SD=0.30), with a mean difference of -1.40 (t=-15.439, df=32, p=0.000). The Pain Interference difference analysis showed a mean difference of 2.69 (SD=1.11), 95% CI: 2.30-3.08, t=14.08, df=33, p=0.000. Overall, the digital-based isometric exercise intervention program proved effective in significantly reducing pain severity and pain interference compared to standard care in the control group.

Discussion

The effect of digital intervention-based isometric exercise on the severity of pain and muscle strength in post-ORIF upper extremity fracture patients.

This study shows that the mean pain severity levels and muscle strength in the intervention group and control group experienced very significant differences. For pain levels, the intervention group had decreased pain levels and improved quality of life as measured using BPI-SF. This is because in addition to patients receiving routine analgesic therapy, post-ORIF patients received isometric exercise, where isometric training can help reduce pain in patients with musculoskeletal conditions. This occurs through pain inhibition mechanisms and increased blood flow to the injured area (Hashim et al., 2022). The measurement results using BPI-SF showed better pain level reduction in the intervention group compared to the control group.

The effectiveness of isometric exercise in reducing pain can be explained through several physiological mechanisms that occur in the body. First, based on the Gate Control theory, isometric movements are able to activate large-diameter nerve fibers (A-beta) that have a low stimulation threshold. When these nerve fibers are activated, there is a closure of the pain transmission "gate" in the spinal medulla, thereby reducing pain perception carried by C and A-delta nerve fibers (Liu et al., 2022).

The second mechanism relates to increased blood circulation to the injured area. Regular isometric contractions can increase blood flow, which plays an important role in delivering oxygen and nutrients to injured tissues (Lakoro et al., 2024). Additionally, increased circulation also helps remove metabolites that can trigger pain, thus indirectly contributing to reducing pain sensations experienced by patients.

Isometric exercise also stimulates the body to release endorphins, known as the body's natural opiates. The release of endorphins plays an important role in the pain modulation process and provides natural analgesic effects, thus helping reduce dependence on pharmacological analgesics

(Febryandy & Fadilah, 2024). In post-ORIF patients, controlled isometric movements also help improve joint stability without placing excessive pressure on the area that has just undergone surgery (Barker et al., 2020).

The use of digital platforms in implementing isometric exercise provides added value in the rehabilitation process. Interactive digital interfaces have been proven to increase patient motivation and compliance in performing exercises. This system allows patients to monitor their progress directly, which has a positive impact on pain perception and the overall recovery process (Houchen-Wolloff et al., 2020). Digital platforms also facilitate standardization in providing exercise instructions and enable real-time monitoring of patient compliance.

The combination of analgesic therapy with isometric exercise shows optimal synergistic effects in pain management. While analgesics work through pharmacological pathways, isometric exercise provides benefits through non-pharmacological mechanisms. This combination approach results in more comprehensive and effective pain management. Digital-based systems also allow adjustment of exercise intensity based on individual responses and more accurate documentation of patient progress.

Furthermore, regularly performed isometric exercise plays an important role in preventing post-operative muscle atrophy. When patients perform isometric contractions, there is increased motor unit activity in muscles that triggers neuromuscular adaptation. This process involves more optimal muscle fiber recruitment and improved neuromuscular coordination, thus helping maintain muscle mass and strength during the immobilization period post-ORIF (Rustikarini et al., 2023).

In the early rehabilitation phase, isometric contractions can maintain muscle tone without causing movement in the newly operated joint. This exercise stimulates muscle protein synthesis and inhibits proteolysis processes that can cause muscle protein degradation during immobilization periods. As a result, patients can maintain muscle mass that directly correlates with muscle strength. The increased blood flow resulting from isometric contractions also contributes to maintaining muscle strength. Better circulation ensures adequate oxygen and nutrient supply to muscle tissues, and facilitates removal of metabolic products that can inhibit optimal muscle function (Monticone et al., 2021). This process is very important in maintaining muscle tissue health during the healing process. The findings in this study strengthen the results of previous research on the effectiveness of isometric exercise in musculoskeletal rehabilitation (Kostadinović et al., 2020). The innovation of using digital platforms provides added value in terms of better accessibility and monitoring, thus enabling optimal rehabilitation outcomes in post-ORIF upper extremity fracture patients (Hatwar et al., 2022).

CONCLUSION

A study on 34 post-ORIF upper extremity fracture patients (17 people per group) showed that digital-based isometric exercise provided highly effective results. Both groups had equivalent baseline characteristics in various demographic and clinical aspects.

The results showed that the group receiving digital-based isometric exercise experienced more significant muscle strength improvement (from 14.82 to 21.18) compared to the standard care group (from 14.82 to 16.94). In terms of pain, the intervention group also showed better improvement with greater reduction in pain severity (5.07→3.25 vs 6.26→4.24) and pain interference (5.37→3.64 vs 6.62→5.05) compared to the control group.

In conclusion, digital-based isometric exercise proved to be highly effective, safe, and consistent in improving muscle strength and reducing pain in post-ORIF upper extremity fracture patients, and can therefore be recommended as an adjunctive therapy for similar conditions.

REFERENCES

Barker, K. L., Newman, M., Stallard, N., Leal, J., & ... (2020). Physiotherapy rehabilitation for osteoporotic vertebral fracture—a randomised controlled trial and economic evaluation (PROVE trial). *Osteoporosis* …. https://doi.org/10.1007/s00198-019-05133-0

Berg, O. K., Stutzer, J. M., Hoff, J., & ... (2021). Early maximal strength training improves leg strength and postural stability in elderly following hip fracture surgery. ... *Orthopaedic Surgery &* …. https://doi.org/10.1177/21514593211015103

Cioroiu, S. G. (2023). Recovery of the Diaphyseal Fracture of the Humerus by Kinetic Means. *Bulletin of the Transilvania University of Braşov* …. https://webbut.unitbv.ro/index.php/Series_IX/article/view/4861

Diyanto, D., Febryandy, F., & Irawan, A. G. (2023). Efektifitas Terapi Akupresur terhadap Kualitas Hidup Pasien Selama Hemodialisa: Studi Systematic Review dan Meta-Analysis. *Indonesia Journal of Nursing Science and Practice*, *6*, 27–34. https://doi.org/10.24583/ijnsp.6.1.27-34

Fan, Y., Bai, D., Cheng, C., & Tian, G. (2023). The effectiveness and safety of blood flow restriction training for the post-operation treatment of distal radius fracture. *Annals of Medicine*. https://doi.org/10.1080/07853890.2023.2240329

Farzad, M., MacDermid, J. C., Mehta, S., Grewal, R., & ... (2021). … -immobilization pain at rest, movement evoked pain, and their ratio as potential predictors of pain and disability at six-and 12-months after distal radius fracture. *Archives of* …. https://doi.org/10.1186/s40945-021-00101-6

Febryandy, V., & Fadilah, R. (2024). EFFEKTIVITAS INTERVENSI BACK MASSAGE TERHADAP PENURUNAN ANXIETY PADA PASIEN CONGESTIVE HEARTFAILURE (CHF) : A SYSTEMATIC REVIEW. *ZAHRA: JOURNAL OF HEALTH AND MEDICAL RESEARCH*, *4*(3), 340–359.

Gatty, A., Samuel, S. R., Alaparthi, G. K., & ... (2022). Effectiveness of structured early mobilization protocol on mobility status of patients in medical intensive care unit. ... *Theory and Practice*. https://doi.org/10.1080/09593985.2020.1840683

Hashim, N. N., Azizan, A., & Rahman, F. (2022). Exercise training with adaptation activities on strength and depression in elderly with post-stroke Dementia: A case study. *International Journal of Aging* …. http://ijahm.com/index.php/IJAHM/article/view/40

Hatwar, V. A., Kulkarni, C. A., & Patil, S. (2022). Rehabilitation and management of complex multiple para-symphysis mandible fracture: a case report. *Cureus*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9727580/

Houchen-Wolloff, L., Essop-Adam, A., Calver, R., & ... (2020). Post-operative rehabilitation in ankle and hindfoot/midfoot fusion and reconstruction surgery-a scoping survey of UK foot and ankle surgeons and allied health …. *Journal of Clinical* …. https://doi.org/10.1177/2473011420S00261

Kerschan-Schindl, K., Widhalm, H., Pataraia, A., & ... (2024). Sentinel fracture: the necessity of improved post-fracture care. *Wiener Medizinische* …. https://doi.org/10.1007/s10354-024-01066-4

Kostadinović, S., Milovanović, N., & ... (2020). … of the lumbar stabilization and thoracic mobilization exercise program on pain intensity and functional disability reduction in chronic low back pain patients with lumbar …. *Journal of Back and* …. https://content.iospress.com/articles/journal-of-back-and-musculoskeletal-rehabilitation/bmr201843

Lakoro, D. D. K., Natashia, D., Gayatri, D., Irawati, D., Jumaiyah, W., & Nuraini, T. (2024). Cognitive Behavioral Therapy (CBT-I) Terhadap Kualitas Tidur Pasien Gagal Ginjal Yang Menjalani Hemodialisis. *MAHESA : Malahayati Health Student Journal*, *4*(8), 3551–3561. https://doi.org/10.33024/mahesa.v4i8.15079

Liu, J., Chen, L., Long, C., Zhang, X., Gao, F., Duan, X., & ... (2022). Effect of a preoperative mobilization program on perioperative complications and function recovery in older adults with femoral neck fracture. *Geriatric Nursing*. https://www.sciencedirect.com/science/article/pii/S0197457222000131

Martinez-Catalan, N. (2023). Conservative treatment of proximal Humerus fractures: When, how, and what to expect. *Current Reviews in Musculoskeletal Medicine*. https://doi.org/10.1007/s12178-022-09817-9

Monticone, M., Portoghese, I., Cazzaniga, D., & ... (2021). Task-oriented exercises improve disability of working patients with surgically-treated proximal humeral fractures. A randomized controlled trial with one-year …. *BMC Musculoskeletal* …. https://doi.org/10.1186/s12891-021-04140-9

Rustikarini, W., Santoso, T. B., & ... (2023). MANAGEMENT PENANGANAN FISIOTERAPI PADA KASUS POST ORIF FEMUR DEXTRA EC. FRAKTUR FEMUR DEXTRA DI PKU BANTUL YOGYAKARTA. *Journal of Innovation* …. https://www.bajangjournal.com/index.php/JIRK/article/view/5806

Worraphan, S., Thammata, A., Chittawatanarat, K., & ... (2020). Effects of inspiratory muscle training and early mobilization on weaning of mechanical ventilation: a systematic review and network meta-analysis. *Archives of Physical* …. https://www.sciencedirect.com/science/article/pii/S0003999320304561