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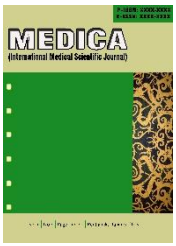

Nursing Interventions for Bone Healing After Open Reduction and Internal Fixation: A Scoping Review

Faisal Abda'u[1]✉, Kumboyono[2], Laily Yuliatun[2]

[1] Master of Nursing Study Program, Department of Nursing, Faculty of Health Science, Universitas Brawijaya, Malang, East Java, Indonesia
[2] Department of Nursing, Faculty of Health Science, Universitas Brawijaya, Malang, East Java, Indonesia

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Abstract

Nursing care plays an important role in supporting postoperative recovery and optimizing clinical outcomes in patients undergoing Open Reduction and Internal Fixation (ORIF). However, nursing interventions that support bone healing in this population have not been comprehensively mapped. This scoping review aimed to identify and map nursing interventions that support bone healing and postoperative recovery in patients undergoing ORIF. Literature searches were conducted in PubMed, ScienceDirect, ProQuest, and Google Scholar using keywords based on the Population–Concept–Context (PCC) framework for studies published between 2015 and 2025. Article screening and selection were conducted using predefined inclusion and exclusion criteria in accordance with the PRISMA-ScR guidelines. Data from the included studies were extracted, categorized, and synthesized thematically. A total of 20 studies were included in this review. The findings demonstrated that nursing interventions could be classified into four major domains: observational, therapeutic, educational, and collaborative interventions. Frequently reported interventions included pain management, early mobilization and rehabilitation support, clinical monitoring, health education, discharge planning, nutritional support, and multidisciplinary collaboration. The reviewed studies suggested that these interventions were associated with improved postoperative clinical outcomes, including reduced pain and complications, enhanced mobility and functional recovery, improved self-care ability, and better quality of life. However, most studies evaluated indirect clinical outcomes rather than direct radiographic indicators of bone healing. Further research is needed to evaluate the effectiveness of specific nursing interventions on radiographic bone healing outcomes across different fracture types and patient populations.

Corresponding Author:
✉ Faisal Abda'u
Master of Nursing Study Program, Department of Nursing, Faculty of Health Science, Universitas Brawijaya, Malang, East Java, Indonesia
Email: fabda39u@gmail.com

1. INTRODUCTION

Bone healing is a complex biological and mechanical process that is initiated immediately in response to fracture. This process involves coordinated cellular responses, vascularization, and mechanical stability at the fracture site to restore bone structure and function (Gläser et al., 2025; Papachristou et al., 2021). Advances in surgical treatment have significantly improved fracture management. However, complications such as delayed union and nonunion remain common following surgery, with reported prevalence reaching approximately 10–15% in certain patient populations (Bowers & Anderson, 2024). Open Reduction and Internal Fixation (ORIF) is considered the gold standard for fracture management, as it enables anatomical reduction of bone fragments and provides internal stability through the use of metal implants, thereby supporting functional recovery and bone healing (Kuo et al., 2025).

Bone healing process after ORIF influenced by multiple factors, including patient-related factors, fracture characteristics, and surgical management (Salama et al., 2021; Wang et al., 2026; Zhou & Cheng, 2025). Patient-related factors such as older age, poor nutritional status, comorbidities, smoking, and obesity have been associated with an increased risk of delayed union or nonunion (Sanchez et al., 2023). In addition, mechanical factors, including inadequate fixation stability and fracture complexity, may influence bone healing (Bowers & Anderson, 2024; Kuo et al., 2025). Postoperative complications, such as surgical site infections and delays between injury and stabilization, may hinder bone consolidation by disrupting biological healing and compromising fragment stability (Gläser et al., 2025; Kuo et al., 2025). These conditions not only result in functional limitations and chronic pain but also increase the economic burde on patients and healthcare systems due to the need for additional care and loss of productivity (Bowers & Anderson, 2024; Macera et al., 2018; Salama et al., 2021).

Nurses play a key role in preventing complications and supporting recovery in patients with fractures undergoing ORIF through continuous nursing care across the preoperative, intraoperative, and postoperative phases (Perera & Ranaweera, 2025). Optimal nursing care at each of these phases is essential to promote biological and mechanical conditions that support bone healing, thereby reducing the risk of complications. Bone healing outcomes are not only reflected in radiographic findings or bone stability (e.g., union and malunion) but can also be assessed using various clinical indicators, including pain levels, functional ability, patient mobility, length of stay, and hospital readmission (Buchmann et al., 2022; Marazzi et al., 2020; Smadi et al., 2025; Stewart et al., 2025).

Nurses play an important role in supporting recovery and preventing postoperative complications in patients undergoing ORIF through perioperative nursing care, including patient assessment, clinical monitoring, rehabilitation support, pain management, health education, and follow-up care (Li et al., 2022 ; Liu et al., 2022). These interventions have been associated with improved postoperative clinical outcomes, such as reduced pain and complications, enhanced mobility and functional recovery, and shorter length of stay. In orthopedic nursing practice, perioperative care is delivered through integrated and multidisciplinary approaches to support patient recovery and optimize functional outcomes.

Although previous studies have reported the benefits of perioperative nursing care and postoperative rehabilitation in patients undergoing ORIF, evidence specifically mapping nursing interventions that support bone healing remains fragmented. Furthermore, the clinical outcomes reported across studies vary considerably, ranging from pain reduction and mobility improvement to complication prevention and functional

recovery, making it difficult to identify the scope of nursing practices associated with bone healing support. Therefore, this scoping review aims to map the existing evidence on nursing interventions that support bone healing and postoperative recovery following ORIF.

2. METHOD

This study employed a scoping review design to identify and synthesize relevant literature from multiple research articles addressing a similar topic. The findings were then categorized and summarized to provide an overview of the existing evidence.

The literature search was conducted using the PCC (Population-Concept-Context) framework, as illustrated in Table 1. Relevant articles were identified using predefined keywords combined with the Boolean operators “AND” and “OR” across four databases: Google Scholar, ScienceDirect, ProQuest, and PubMed.

Table 1. PCC strategy.

Element	Criteria	Keywords
P (Population)	Patients with fractures treated with ORIF	("Open Reduction and Internal Fixation" OR ORIF OR "internal fixation")
C (Concept)	Nursing interventions supporting bone healing	("nursing care" OR "nursing intervention" OR "postoperative nursing" OR "orthopedic nursing")
C (Context)	Clinical outcomes related to bone healing after ORIF (e.g., pain, swelling, mobility, functional recovery, complications, or fracture union)	("bone healing" OR "fracture healing" OR "bone union")

The inclusion criteria were as follows journal articles focusing on nursing interventions that promote bone healing in patients treated with ORIF, articles published between 2015 and 2025, original research written in English, and available as open-access full texts. Review articles, conference proceedings, editorials, and case reports were excluded.

The article selection and screening process was conducted independently by three authors based on the predefined inclusion and exclusion criteria. A systematic selection process was applied using the PRISMA-ScR flowchart (Figure 1), resulting in a total of 20 articles included in the review.

The methodological quality of included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to the study design. Randomized controlled trials were assessed using the JBI Checklist for Randomized Controlled Trials, quasi-experimental studies using the JBI Checklist for Quasi-Experimental Studies, and retrospective studies using the JBI Checklist for Cohort Studies. The appraisal process was conducted independently by two reviewers, and disagreements were resolved through discussion until consensus was achieved.

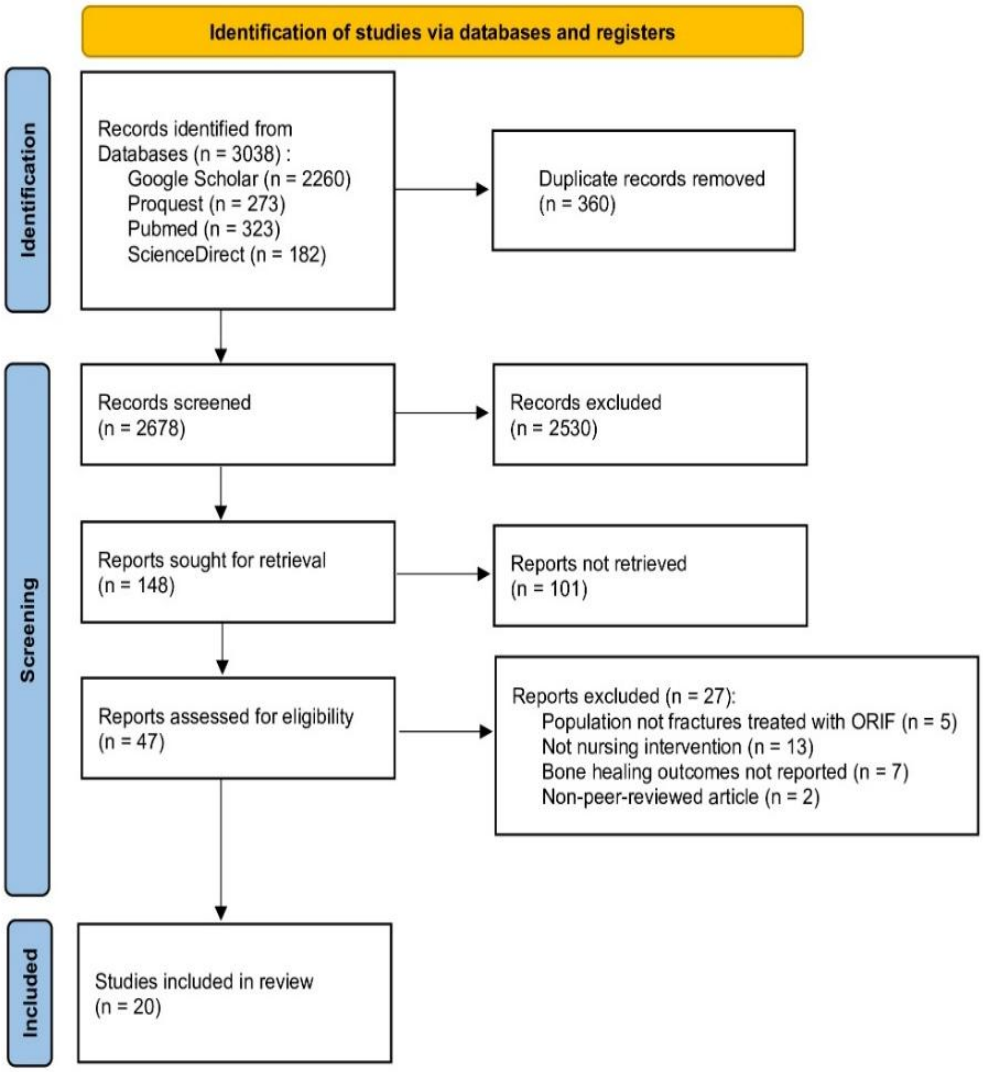

Figure 1. PRISMA flow diagram of article selection.

3. RESULTS AND DISCUSSION

A total of 20 studies published between 2016 and 2025 met the inclusion criteria in this review. The included studies consisted of randomized controlled trials (n=7), quasi-experimental studies (n=9), retrospective studies (n=3), and secondary data analysis of randomized controlled trials (n=1). Most studies were conducted in China, followed by Taiwan, Egypt, Indonesia, and Japan. The fracture populations included hip fractures, femoral fractures, ankle fractures, distal radius fractures, pelvic fractures, thoracolumbar vertebral fractures, and other extremity fractures treated with ORIF. The nursing interventions identified were grouped into four main domains: observational, therapeutic, educational, and collaborative interventions.

Therapeutic interventions were the most frequently reported and included pain management, early mobilization, rehabilitation exercises, positioning, psychological support, and complication prevention (Wang et al., 2021; J. Shi et al., 2023; Zhang et al., 2025).

Table 2. Characteristics of Included Studies, Nursing Interventions, and Postoperative Outcomes Following ORIF.

No	Author, Year	Country	Study Design	Participants	Main Findings	
					Nursing Interventions	**Bone Healing Related Outcomes**
1	(M. Wang et al., 2021)	China	Retrospective study	112 older adults (> 65) with hip fracture undergoing surgery; conventional nursing care (n=56) vs NSOF (n=56)	Standardized nursing care bundle (NSOF): Early mobilization Exercise Nutritional management and monitoring Pain assessment and management Fluid balance Prevention of complications and secondary fracture	Early weight-bearing within 24 h Reduced length of stay Lower refracture incidence (6-month follow-up) Improved mobility
2	(Shyu et al., 2016)	Taiwan	Randomized controlled trial	299 older adults (≥ 60) with first-time hip fracture undergoing surgery; interdisciplinary care (n=101), comprehensive care (n= 99), usual care (n=99)	Interdisciplinary care: Geriatric consultation Early rehabilitation Home visit Discharge planning Comprehensive care: Extended home rehabilitation Nutritional management Depression management Fall prevention	Improved ADL (Activity Daily Living) Barthel Index Improved Instrumental Activities of Daily Living Reduced emergency visits
3	(M. Y. Tseng et al., 2021)	Taiwan	Randomized controlled trial	152 older adults (≥60) with hip fracture and cognitive	Family-centered care model: Geriatric assessment	Improved nutritional status

				impairment; experimental (n=76), control n=76)	Discharge planning Home environment assessment Rehabilitation program Family caregiver training	Improved self-rated health status
4	(Zhang et al., 2025)	China	Randomized controlled trial	72 patients with ankle fractures undergoing surgery; IPC group (n=36), routine care group (n=36)	Integrated nursing care combined with intermittent pneumatic compression (IPC): Psychological care Nutritional support Postoperative monitoring Pain management Rehabilitation guidance IPC therapy	Reduced postoperative pain Improved ankle joint function Increased ankle range of motion Reduced risk of postoperative complications Improved psychological status Improved quality of life
5	(Ueyama et al., 2024)	Japan	Retrospective study	44 patients with periprosthetic femoral fractures proximal to the stem fixation site without stem loosening; non-surgical group (n= 32), surgical fixation group (n=12)	Post-operative management: Pain control Early weight-bearing rehabilitation Rehabilitation program	Reduced postoperative pain Shorter time to first weight-bearing Shorter time to independent ambulation Reduced ADL decline Higher bone union rate Lower risk of postoperative complications Lower reoperation rate

6	(X. Shi & Ma, 2024)	China	Retrospective study	96 older adults (≥60) with femoral intertrochanteric fractures undergoing surgery; collaborative nursing group: (n=48), routine nursing group (n=48)	Collaborative nursing intervention based on Roy Adaptation Model (RAM): Health education Psychological nursing Postoperative care Rehabilitation nursing Complication prevention Diet guidance	Improved hip joint function Higher proportion of excellent-good hip function recovery Reduced postoperative pain Improved quality of life Lower risk of postoperative complications
7	(He et al., 2022)	China	Retrospective study	150 patients undergoing surgery; Intervention group (n=87), control group (n=63)	HFMEA-based predictive care combined with multimodal analgesia: Health education for patients and families Psychological support Postoperative analgesia management Risk management and prevention of adverse events Rehabilitation guidance	Reduced postoperative pain Reduced analgesic use Lower inflammatory markers Lower risk of postoperative complications Improved self-care ability Improved psychological status
8	(Tang & Dai, 2023)	China	Randomized controlled trial	96 patients with Colles fracture after surgery; intervention group (n=48), control group (n=48)	WeChat-based follow-up and continuous nursing intervention: Rehabilitation guidance Psychological support Diet guidance	Improved follow-up adherence Improved wrist function Improved self-care ability Lower risk of postoperative complications

					Complication prevention education Professional consultation	
9	(J. Shi et al., 2023)	China	Quasi-experimental	140 patients with femoral neck fracture after surgery; observation group (n=70), control group (n=70)	Ankle pump exercise-based nursing intervention assisted by ankle pump counter system: Ankle pump exercise education Guided ankle pump exercise Bedside movement supervision Digital exercise monitoring Rehabilitation support	Reduced postoperative pain Improved ADL Reduced lower limb fatigue Reduced lower limb swelling Improved adherence to ankle pump exercise Improved self-care efficacy Lower incidence of DVT
10	(M.-Y. Tseng et al., 2022)	Taiwan	Secondary Data Analysis of a Randomized Controlled Trial	134 older adults with cognitive impairment recovering from hip fracture surgery; intervention group (n=69), control group (n=65)	Family-centered care intervention involving family caregivers: Geriatric assessment Nutritional consultation Discharge planning Home environment assessment Postoperative rehabilitation program (hip strengthening exercises) Family caregiver training	Improved ADL Improved Instrumental Activities of Daily Living Increased hip muscle strength Increased hip range of motion Improved physical quality of life
11	(Fan et al., 2019)	China	Quasi-experimental	114 patients with femoral	Comprehensive care based on	Improved ADL

				intertrochanteric fracture undergoing surgery; intervention group (n=57), control group (n=57)	feedforward control: Risk assessment Complication prevention planning Preoperative care (psychological counseling, disease assessment, and preoperative functional training) Postoperative care (infection prevention, rehabilitation exercise guidance, and dietary care) Discharge health guidance Telephone follow-up monitoring	Reduced length of stay Improved lower limb motor function Improved quality of life Reduced anxiety and depression Lower complication incidence
12	(Sun et al., 2022)	China	Quasi-experimental	82 elderly patients with femoral neck fracture receiving postoperative treatment; intervention group (n=41), control group (n=41)	Predictive nursing: Create comfortable ward environment Psychological counselling Pain management Complication prevention care	Improved ADL Reduced pain Lower complication incidence
13	(Ding & Huang, 2025)	China	Retrospective study	145 adult patients with closed pelvic fracture undergoing surgery; intervention group	Responsibility system management nursing model: Development of individualized planning Preventive care	Lower DVT incidence Improved hip function Reduced pain Reduced length of stay

				(n=70), control group (n=75)	Rehabilitation exercise Health education Psychological support	Shorter time to first mobilization Lower readmission rate
14	(Mostafa & Osman, 2020)	Egypt	Quasi experimental	60 adult patients undergoing surgery; intervention group (n=30), control group (n=30)	Postoperative nursing instruction program: Health education Post-operative instructions Follow up visits	Improved wound healing Lower complication incidence Improved neurovascular status
15	(Yuan et al., 2024)	China	Retrospective study	114 patients with distal radius fractures undergoing surgery; intervention group (n=60), control group (n=54)	Rehabilitation nursing intervention: Provide comfortable hospital environment Rehabilitation exercises Psychological support	Reduced pain Reduced limb swelling Shorter healing time Faster recovery of limb mobility Reduced length of stay Improved wrist function Improved quality of life Reduced anxiety and depression
16	(Liu et al., 2022)	China	Quasi experimental	90 patients with femoral fracture undergoing surgery; intervention group (n=45), control group (n=45)	Operating room nursing based on clinical quantitative assessment combined with WeChat health education: Preoperative clinical quantitative assessment Operating room nursing care	Reduced length of stay Shorter time to weight-bearing Shorter fracture healing time Reduced postoperative pain Improved hip function Lower complication incidence

					Health education	Improved self-care ability Improved quality of life
17	(Mohamed et al., 2023)	Egypt	Quasi-experimental	60 adult patients with lower limb fractures treated surgery: intervention group (n=30), control group (n=30)	Nursing intervention protocol: Health education Wound care Pain management Nutritional guidance Medication and follow-up instructions Exercise training	Improved neurovascular status Lower pressure ulcer incidence Lower pin site infection incidence Increased lower lib range of motion
18	(Li et al., 2022)	China	Quasi-experimental	100 patients with thoracolumbar vertebral fractures undergoing surgery; intervention group (n=50), control group (n=50)	Postural nursing intervention: Preoperative nursing preparation Intraoperative nursing cooperation Intraoperative pressure injury prevention Postural positioning care Skin and pressure area care	Reduced length of stay Lower pressure ulcer incidence Lower complication incidence Reduced postoperative pain
19	(Purwanty et al., 2021)	Indonesia	Quasi-experimental	34 adult patients undergoing lower extremity surgery; intervention group (n=17), control group (n=17)	20° lower extremity elevation Ankle pumping exercise	Reduced postoperative swelling Reduced postoperative pain

20	(Febryandy et al., 2025)	Indonesia	Quasi-experimental	34 patients undergoing upper extremity surgery; intervention group (n=17), control group (n=17)	Digital-based isometric exercise intervention: Exercise education Exercise frequency protocol Follow-up monitoring	Increased upper limb muscle strength Reduced postoperative pain Reduced pain-related activity interference

The findings summarized in Table 2 were further mapped in Figure 2 illustrate nursing interventions that support bone healing in patients following ORIF. These interventions were thematically grouped based on similarities in their characteristics and aligned with the classification of nursing interventions in clinical practice into four main categories: observation, therapeutic, education, and collaboration.

Table 3. Methodological Quality Assessment of Included Studies Using JBI Criteria.

Author	Design	JBI score	Overall appraisal
(M. Wang et al., 2021)	Retrospective study	8/10	Moderate
(Shyu et al., 2016)	Randomized Controlled Trial	11/13	High
(M. Y. Tseng et al., 2021)	Randomized Controlled Trial	11/13	High
(Zhang et al., 2025)	Randomized Controlled Trial	12/13	High
(Ueyama et al., 2024)	Retrospective study	8/10	Moderate
(X. Shi & Ma, 2024)	Retrospective study	8/10	Moderate
(He et al., 2022)	Retrospective study	7/10	Moderate
(Tang & Dai, 2023)	Randomized Controlled Trial	11/13	High
(J. Shi et al., 2023)	Quasi-experimental	7/9	Moderate
(M.-Y. Tseng et al., 2022)	Secondary analysis of RCT	10/13	High
(Fan et al., 2019)	Quasi-experimental	7/9	Moderate
(Sun et al., 2022)	Quasi-experimental	7/9	Moderate
(Ding & Huang, 2025)	Retrospective study	8/10	Moderate
(Mostafa & Osman, 2020)	Quasi-experimental	6/9	Moderate
(Yuan et al., 2024)	Retrospective study	8/10	Moderate
(Liu et al., 2022)	Quasi-experimental	7/9	Moderate
(Mohamed et al., 2023)	Quasi-experimental	6/9	Moderate
(Li et al., 2022)	Quasi-experimental	7/9	Moderate
(Purwanty et al., 2021)	Quasi-experimental	6/9	Moderate
(Febryandy et al., 2025)	Quasi-experimental	7/9	Moderate

Notes:

1. *Randomized controlled trials were assessed using the JBI Critical Appraisal Checklist for Randomized Controlled Trials (13 items).*
2. *Quasi-experimental studies were assessed using the JBI Checklist for Quasi-Experimental Studies (9 items).*
3. *Retrospective studies were assessed using the JBI Checklist for Cohort Studies (10 items).*
4. *Studies scoring ≥ 70% were categorized as high quality, while scores between 50–69% were categorized as moderate quality*

Educational interventions focused on rehabilitation guidance, nutritional education, home care, and caregiver training (Tang & Dai, 2023 ; M.-Y. Tseng et al., 2022). Collaborative interventions involved discharge planning, multidisciplinary rehabilitation, nutritional consultation, and follow-up care (Shyu et al., 2016; M.-Y. Tseng et al., 2022), while observational interventions emphasized monitoring pain, wound condition, vital signs, nutritional status, rehabilitation adherence, and postoperative complications. Overall, the identified nursing interventions were associated with reduced pain and complications, improved mobility and activities of daily living, enhanced functional recovery, and better quality of life following ORIF.

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to each study design. Overall, most included studies demonstrated moderate to high methodological quality. The randomized controlled trials generally showed good methodological rigor, particularly in randomization, baseline comparability, and outcome assessment. However, several studies did not clearly report allocation concealment and blinding procedures. Meanwhile, the quasi-experimental and retrospective studies adequately described interventions and outcome measurements but showed several limitations related to confounding control, participant selection, and risk of selection bias. Despite these limitations, the included studies were considered sufficiently robust to support the synthesis of evidence regarding nursing interventions and postoperative recovery following ORIF.

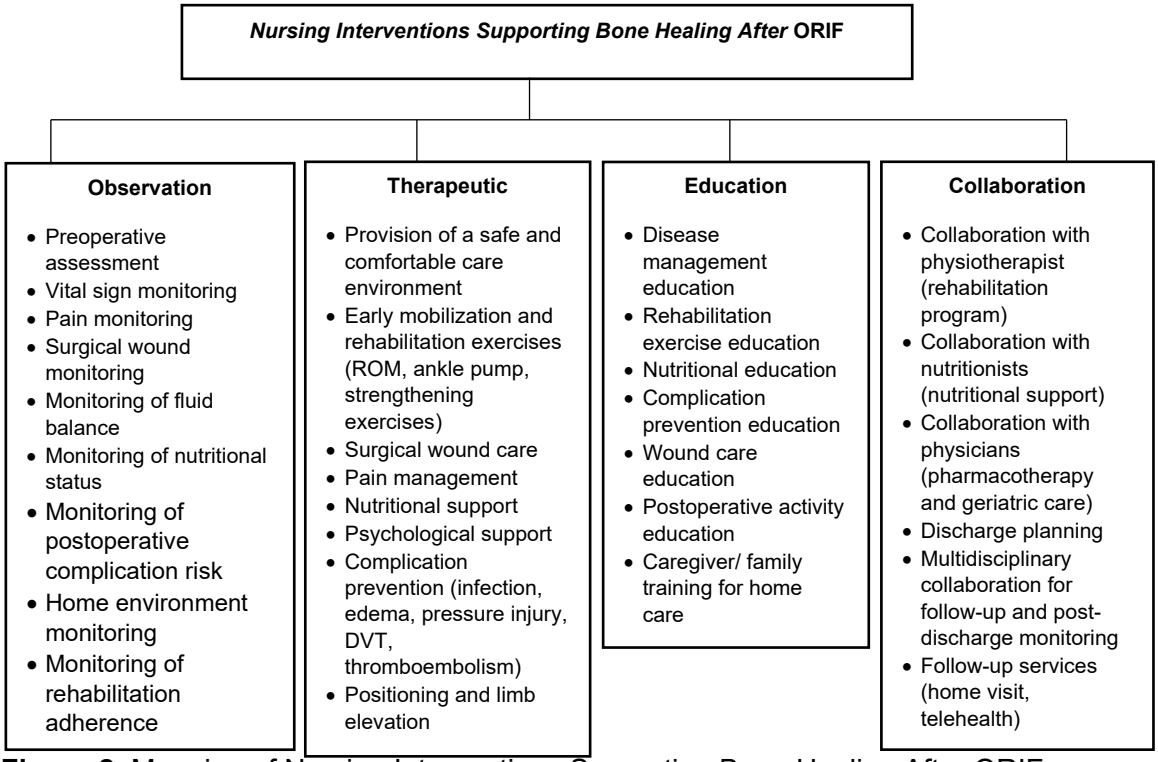

Figure 2. Mapping of Nursing Interventions Supporting Bone Healing After ORIF

Based on the evidence mapping in this review, nursing interventions following ORIF should not be viewed merely as supportive postoperative care, but rather as interventions that contribute to optimizing the biological and functional conditions required for fracture healing. The findings indicate that orthopedic nursing has a strategic role within the fracture healing continuum through pain management, early mobilization, rehabilitation support, complication monitoring, patient education, and multidisciplinary coordination.

The predominance of therapeutic interventions across the included studies suggests that contemporary orthopedic nursing practice has shifted from maintenance-oriented care toward a recovery-oriented approach emphasizing functional restoration and complication prevention. This perspective aligns with the concept of accelerated rehabilitation surgery, which positions nurses as key contributors in optimizing postoperative recovery pathways in orthopedic patients (Lv & Yang, 2021). Furthermore, the holistic perspective of orthopedic nursing, integrating physical, psychological, and social dimensions throughout perioperative care, reinforces the importance of nursing-centered recovery management in improving postoperative outcomes after ORIF (Palmer, 2018).

Early mobilization and rehabilitation exercises emerged as the most consistently reported therapeutic interventions in this review. Clinically, these findings strengthen the argument that successful recovery following ORIF is determined not only by fixation stability and surgical technique, but also by the optimization of postoperative rehabilitation through structured nursing interventions. Previous studies have demonstrated that early mobilization and progressive weight-bearing may improve joint function, preserve muscle strength, enhance mobility, and reduce complications associated with prolonged immobilization without increasing the risk of delayed union or nonunion (Barlow et al., 2023; Gross et al., 2016; Watson et al., 2018). From a biological perspective, controlled mechanical stimulation during early mobilization may activate mechanotransduction pathways and bone remodeling processes that support fracture healing (Zhou & Cheng, 2025)Therefore, rehabilitation-related nursing interventions should no longer be regarded as complementary care, but rather as integral components of evidence-based orthopedic recovery strategies. Nevertheless, variations in rehabilitation protocols across studies indicate that the effectiveness of early mobilization may depend on fracture type, fixation stability, patient age, and weight-bearing tolerance, suggesting the need for individualized rehabilitation approaches based on patient-specific clinical conditions.

Pain management also emerged as a central component across nearly all included studies. This finding suggests that postoperative pain following ORIF is not merely a clinical symptom, but also a factor that may influence rehabilitation participation, mobility, quality of life, and overall recovery trajectory. Multimodal pain management approaches combining pharmacological and non-pharmacological interventions, including positioning, distraction techniques, relaxation exercises, psychological support, and patient education (Sun et al., 2022; M. Wang et al., 2021; Zhang et al., 2025), demonstrate the important contribution of nursing care in reducing recovery barriers after orthopedic surgery. Academically, these findings reinforce the positioning of nursing intervntions in ORIF patients as not only improving patient comfort, but also potentially influencing rehabilitation adherence and functional recovery outcomes. In addition, the integration of psychological support in several studies highlights that postoperative recovery after ORIF is a multidimensional process influenced simultaneously by physical and psychosocial conditions (Perera & Ranaweera, 2025).

Observational, educational, and collaborative interventions identified in this review further demonstrate that successful postoperative recovery after ORIF depends heavily on continuity of care and multidisciplinary involvement. Monitoring of pain, surgical wounds, nutritional status, complications, and rehabilitation adherence enables early identification of factors that may hinder recovery (Fan et al., 2019; J. Shi et al., 2023; Zhang et al., 2025). Meanwhile, patient and caregiver education regarding mobilization, exercise, nutrition, and home care indicates that nurses play a crucial role in facilitating the transition from hospital-based recovery to home-based rehabilitation. Family involvement, particularly among geriatric patients, was consistently emphasized because

a substantial proportion of rehabilitation occurs after hospital discharge (M.-Y. Tseng et al., 2022; M. Y. Tseng et al., 2021). Clinically, these findings suggest that discharge planning and family-centered rehabilitation should be positioned as core components of orthopedic nursing practice rather than supplementary interventions. Furthermore, multidisciplinary collaboration involving nurses, physicians, physiotherapists, and nutritionists highlights the need for integrated care models focused on long-term functional recovery rather than solely surgical success.

Despite these positive findings, the current evidence regarding the direct effect of nursing interventions on biological bone healing remains limited. Most included studies primarily evaluated clinical and functional outcomes such as pain reduction, mobility improvement, activities of daily living, and complication prevention rather than direct radiographic indicators such as fracture union or healing time. In addition, substantial heterogeneity in fracture populations, intervention protocols, outcome measures, and study designs limited comparability across studies. Many included studies employed quasi-experimental and retrospective designs that are inherently more vulnerable to selection bias and confounding factors than randomized controlled trials. Therefore, the current body of evidence more strongly supports the contribution of nursing interventions to enhanced postoperative recovery rather than directly demonstrating their impact on biological fracture healing. These findings also highlight an important research gap in orthopedic nursing research, namely the limited availability of rigorous longitudinal and randomized controlled studies evaluating the direct relationship between nursing interventions and radiographic fracture healing outcomes. Future studies should adopt more rigorous methodologies and standardized clinical and radiographic outcome measures to better clarify the contribution of nursing interventions to fracture healing and postoperative orthopedic recovery.

The findings of this review highlight the important role of nursing interventions in supporting postoperative recovery among patients undergoing ORIF. Therapeutic interventions such as pain management, early mobilization, rehabilitation exercises, and complication prevention consistently demonstrated positive effects on functional recovery, mobility, and quality of life. These findings suggest that orthopedic nursing care should be integrated as a core component of postoperative management rather than being viewed solely as supportive care. The evidence also emphasizes the importance of multidisciplinary collaboration, discharge planning, and family-centered rehabilitation to optimize continuity of care after hospital discharge. Clinically, the integration of structured rehabilitation guidance, patient education, and ongoing monitoring may help improve rehabilitation adherence and reduce postoperative complications, particularly among older adults and patients with limited functional capacity

Several limitations should be considered when interpreting the findings of this review. First, substantial heterogeneity existed across the included studies regarding fracture types, intervention protocols, outcome measures, and study designs, which limited direct comparability between studies. Second, most studies focused primarily on indirect clinical and functional outcomes such as pain reduction, mobility improvement, activities of daily living, and complication prevention rather than objective indicators of bone healing, including radiographic union or standardized healing time assessment. Third, many included studies used quasi-experimental and retrospective designs, which are more susceptible to selection bias and confounding factors compared with randomized controlled trials. In addition, the predominance of studies conducted in Asian countries, particularly China, may limit the generalizability of findings to broader healthcare settings and populations. Therefore, the current evidence should be interpreted cautiously, and

future research is needed using rigorous longitudinal and randomized controlled methodologies with standardized radiographic and functional outcome measures to better clarify the direct contribution of nursing interventions to fracture healing after ORIF.

4. CONCLUSION

This scoping review demonstrates that nursing interventions play an important role in enhancing postoperative recovery following Open Reduction and Internal Fixation (ORIF), particularly through early mobilization, rehabilitation support, pain management, patient education, and multidisciplinary coordination. Current evidence consistently indicates positive effects on functional recovery, mobility, complication prevention, and quality of life after surgery, highlighting the strategic role of orthopedic nursing within recovery-oriented care. However, the contribution of nursing interventions to biological bone healing should be interpreted cautiously because most included studies evaluated indirect clinical and functional outcomes rather than objective radiographic indicators of fracture healing. In addition, heterogeneity in study design, fracture populations, and outcome measures limited comparability across studies. Future research should prioritize high-quality multicenter studies with standardized clinical and radiographic outcomes to better clarify the direct relationship between nursing interventions and fracture healing after ORIF.

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