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REVIEW

Early Mobilization in Post-Orthopedic Surgery Patients: A Scoping Review

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Abstract: Post-orthopedic surgery patients need to undergo a recovery process with immobilization to minimize pain or swelling. Maximum care through early mobilization intervention can accelerate the return of body function and minimize medical complications. This literature review aims to determine early mobilization-based interventions that can be applied to post-orthopedic surgery patients. The method used in reviewing this article is a scoping review of secondary data in online databases including EBSCOhost, PubMed, Sage, and ScienceDirect. There are 8 articles analyzed and the early mobilization interventions found include motion interventions (increasing range of motion), Progressive Muscle Relaxation interventions (reducing pain, increasing muscle strength effects and short-term kinesiophobia), weight bearing interventions (reducing stiffness and pain), positioning interventions (reducing post-operative blood loss and increasing range of motion), and Neuromuscular Electrical Stimulation interventions (increasing muscle strengthening). These five types of early mobilization can reduce the length of stay in the hospital. Early mobilization based on motion and PMR showed significantly better results because the range of motion recovery time was faster, which was six weeks after surgery. This literature review can provide additional information for nurses as nursing care providers or other health workers regarding the importance of multidisciplinary collaboration in providing early mobilization interventions in post-orthopedic surgery patients. For further research, it is hoped that it can increase the research sample of post-orthopedic surgery patients in determining the effectiveness of various other early mobilization interventions in post-orthopedic surgery patients so that the review article can cover a wider range.

Plain Language Summary: This literature review was done to describe various types of effective early mobilization that can be carried out in patients after orthopedic surgery to speed up the functional recovery process. Researchers obtained 8 research articles that conducted research related to early mobilization in patients after orthopedic surgery. Early mobilization that can be carried out effectively includes movement, Progressive Muscle Relaxation (PMR), weight bearing, positioning, and Neuromuscular Electrical Stimulation (NMES). This early mobilization intervention has been proven to increase the range of motion, restore muscle function, reduce pain, and reduce the length of stay in the hospital. Various other studies indicate that early mobilization based on motion and PMR results in a better range of motion recovery time than other mobilization interventions.

Keywords: early ambulation, enhanced recovery after surgery, muscle strength, orthopaedic nursing

Introduction

Orthopedics is a medical discipline focusing on the bones, joints, muscles, tendons, nerves, skeletal system, and limbs by diagnosing and managing musculoskeletal disorders, including interconnected soft tissues. Data from the Global Burden of Disease (GBD) shows that around 1.71 billion individuals worldwide experience orthopedic problems.[1] This condition is also the main cause of disability throughout the world. Upper and lower extremity fractures are one of the main problems in orthopedic conditions, with approximately 436 million cases worldwide.[2] The prevalence of upper and lower extremity fracture injuries in Indonesia reaches 5.5%.[3]

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Upper and lower extremity fractures can cause damage to other organs of the body due to the risk of pressure from broken bones.[4] This fracture conditions can be treated through orthopedic surgery that restores bone structure and function to normal. Orthopedic surgery aims to repair problems related to the skeleton, attachments, ligaments, and tendons.[5] Patients with severe arthritis are often recommended to undergo total joint replacement surgery to improve range of motion.[6] After undergoing orthopedic surgery, patients will usually spend time in the hospital for inpatient treatment before being allowed to go home to begin the recovery process.

During the recovery period, patients are asked to rest entirely and are immobilized so that the bone or joint that has been operated on remains in its position.[7] Immobilization is done to reduce pain and swelling in the area of the surgical scar. The patient's physical mobility is impaired due to immobilization due to movement restrictions such as bed rest or physical limits due to external equipment such as gips or skeletal traction. The time required for post-operative recovery or immobilization will vary depending on the type of surgery performed.[8] Based on the data of gait rehabilitation in post-orthopedic surgery patients, patients can recover in a few weeks to months, such as 3 months to 6 months.[9] The gait rehabilitation is assessed from the intensity and duration of physical activity, the number of steps (basic spatial and temporal gait), gait cycle, and step frequency, where the time of gait rehabilitation depends on the patient's early mobilization activities.[10]

Generally, mobilization can be carried out 8 hours after surgery after ensuring that the patient is conscious or the limbs can be moved again after regional anesthesia.[7] However, patient immobilization is often carried out for a long time, significantly reducing muscle strength associated with motor nerve function and central nervous drive and slowing the recovery process.[11] This means most post-orthopedic surgery patients do not perform early mobilization because of the fear of pain in the surgical wound area when moved.[12] In addition, the mobility of post-orthopedic surgery patients is also hampered by several medical devices installed in the body, such as infusions, catheters, nasogastric tubes, drainage tubes, monitor cables, and others.

Finally, most patients require full assistance for mobilization, such as getting out of bed and standing and walking. The necessary level of aid is closely related to length of stay in the hospital, mortality rate, and the risk of medical complications.[13] Long-term immobilization can cause the risk of medical complications in the form of joint stiffness which can cause joint contractures, limited ligament movement, and muscle atrophy.[6] Immobilization can also disrupt metabolic function, such as decreasing metabolic rate and fluid, electrolyte, and calcium imbalances.[14]

Therefore, post-orthopedic surgery patient requires maximum care to accelerate the post-operative recovery process and return of body function by providing early mobilization interventions. Early mobilization is a series of activities that begin after surgery, including light activities in bed to the ability to get out of bed, go to the bathroom, and leave the bed.[14] Early mobilization performed by patients after orthopedic surgery has several risks in the form of hemodynamic instability, pain scale, and possible complaints of nausea or vomiting.[6] However, early mobility is essential for post-orthopedic surgery patients to prevent prolonged healing, muscle stiffness, and limited post-operative movement.[11] Early mobilization is a key component in physiological function because it is essential to maintaining independence. Early mobilization is by involving health workers in the process of guiding patients.[15]

Mobility is an important factor in maintaining the patient's musculoskeletal function. Early mobilization can shorten the length of stay in the hospital, increasing patient mobility, and increasing patient satisfaction after surgery. Therefore, with the problem of the high number of orthopedic surgery cases for upper and lower fractures and the long immobilization time in post-orthopedic surgery patients, this literature review aims to determine early mobilization-based interventions that can be applied to adult patients after orthopedic surgery.

Materials and Methods

Study Design

The method used in reviewing this article is scoping review. The aim of a scoping review is to produce quality information in a shorter period of time by conducting a full quality assessment.[16] There are 9 stages of article review carried out, namely formulating article review questions, formulating article search keywords, selecting criteria,

identifying sources of information, determining article search strategies, article extraction, mapping and collecting articles, reporting the results of article analysis, and consultation with other competent.

Search Strategy

A literature search for review articles was conducted by the first author (PR) using four primers online databases: EBSCOhost, PubMed, Sage, and ScienceDirect. The selection criteria in this article search include inclusion criteria and exclusion criteria. The inclusion criteria for reviewing articles included post-orthopedic surgery patients, articles in the last 5 years (2019–2024), English language articles, articles with clinical trials and randomized controlled trials, and a focus on discussing early mobilization interventions. The exclusion criteria for this article review are articles with the type of literature review research. In searching for articles, the keywords "early ambulation", "enhanced recovery after surgery", "muscle strength", and "orthopaedic nursing" were used. For each term verified by MeSH (Medical Subject Headings), synonyms are used to retrieve all possible relevant articles. In addition, the author uses the Boolean operators "AND" and "OR" to trim or expand the search results for various tenses. The following is the search algorithm for this article (Figure 1).

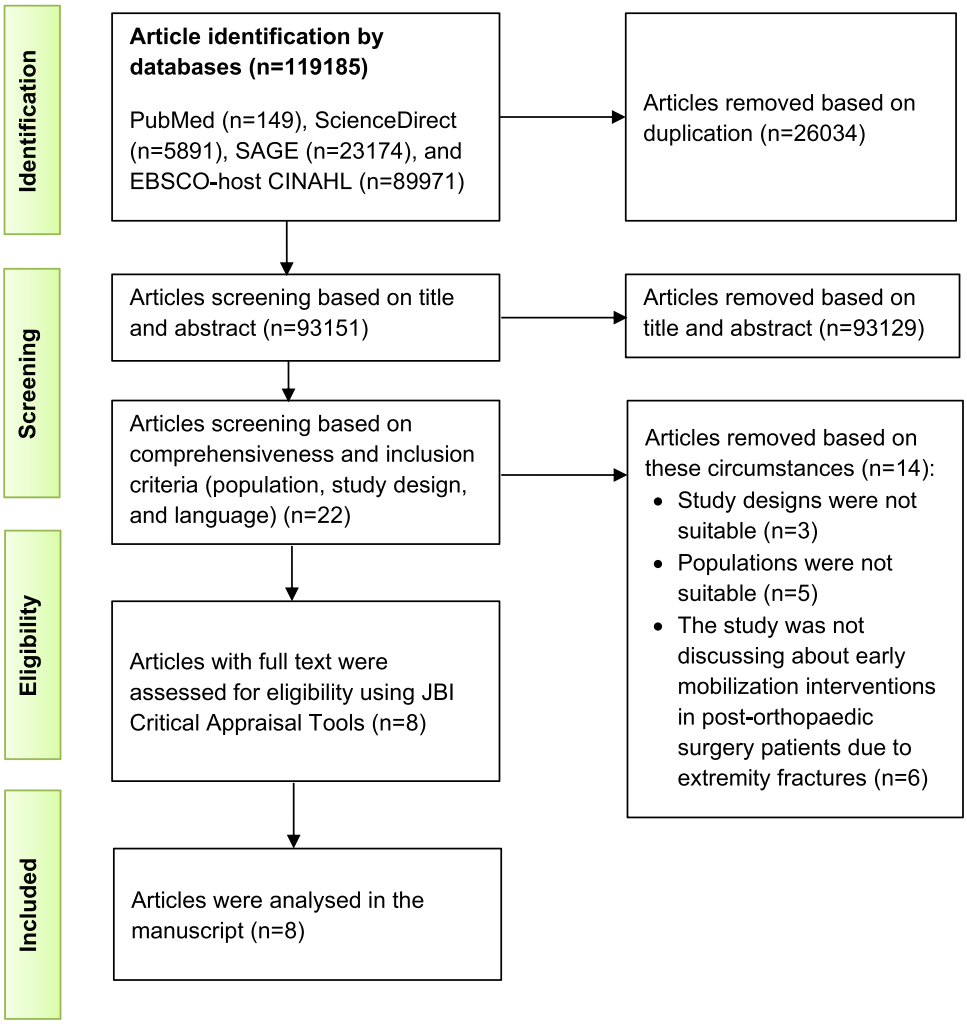

Figure 1 PRISMA flowchart.
Notes: PRISMA figure adapted from Page MJ, McKenzie JE, Bossuyt PM et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021; 372: n71. Creative Commons.[17]

Table 1 JBI Critical Appraisal Results

Study	Design	JBI Critical Appraisal Tool
(Dennison et al, 2020)[19]	RCT	11/13 (84%)
(Eymir et al, 2022)[20]	RCT	12/13 (92%)
(Argut et al, 2021)[21]	RCT	12/13 (92%)
(Kuru et al, 2020)[11]	Case control	8/10 (80%)
(Zou et al, 2019)[22]	RCT	10/13 (77%)
(Ling et al, 2020)[23]	RCT	11/13 (84%)
(Wu et al, 2019)[24]	RCT	13/13 (100%)
(Klika et al, 2022)[25]	RCT	12/13 (92%)

Study Selection

The first author (PR) selected studies that met the eligibility criteria. Literature was chosen by removing articles from the last 5 years (2019–2024), duplicate articles, and articles that did not meet the inclusion criteria. The total number of articles obtained was 93151 articles. The articles were screened and 22 articles were found that met the criteria. Of this number, articles were screened in full text, and eight articles were obtained that could be analyzed. Four authors (PR, NZM, IY, and J) checked each complete text with the Joanna Briggs Institute (JBI) critical assessment checklist. Furthermore, the author (MK) as experts in nursing decides if there is a discrepancy in the selection results. We experienced no differences of opinion regarding the feasibility of the study.

The critical assessment consists of 13 questions for randomized control trial design articles and 10 questions for case-control studies.[18] Each question consists of four response choices "yes", "no", "not applicable", and "unclear". Specifically, the authors calculated the critical appraisal score as the number of "yes" responses divided by the total number of "unclear", "no", and "yes" responses, excluding "not applicable" responses. Four authors eliminated any studies with a JBI score <70%. The results of the JBI that the majority of research was of good quality (>75%) (Table 1).

Literature Identification and Mapping

The selection of literature used in this article review was based on the PRISMA method, and the author analyzed eight articles. Article analysis was done by compiling a matrix table consisting of the author's name, title and year of the article; research purposes; research sample; types of research; orthopaedic surgery area; interventions/procedures; as well as research results.

Results

There are several early mobilization-based interventions to support the recovery process of patients after orthopaedic surgery, which were obtained from 8 articles, including 3 articles related to motion-based early mobilization interventions,[19,22,24] 1 article about early mobilization interventions based on Progressive Muscle Relaxation (PMR) training,[20] 2 articles about early mobilization interventions based on Weight Bearing,[11,23] 1 article about early mobilization interventions based on positioning,[21] and 1 article about early mobilization interventions based on the Neuromuscular Electrical Stimulation (NMES) Application.[25] The following is the analysis matrix for the articles reviewed (Table 2).

Table 2 Results of Article Analysis

No	Author, Year, Dan Country	Research Purposes	Research Sample	Types of Research	Orthopedic Surgery Area	Intervention/Procedure	Results
1.	(Dennison et al, 2020)[19]	To compare the outcomes (strength, movement and outcome and pain scores) of patients treated with an early mobilization protocol or intervention in the form of early and delayed movement after Volar Plating	33 adult patients with unilateral distal radius fractures 1. **Early Motion Group**: The 18 patients in the early mobility group had a mean age of 54.9 years 2. **Delayed Motion Group:** The 15 patients in the slow-motion group had a mean age of 53.1 years	Prospective randomized controlled trial	Unilateral distal radius	**Early Motion Group**: 1. **Days 1–14**: Finger and thumb ROM in a wrist splint 2. **At weeks 2, 4, 6, 8, 10, 12, 26, 52**: Active Range of Motion (AROM), Active Assisted Range of Motion (AAROM), and Passive Range of Motion (PROM) and strengthening gradual (grip strength, Appositional Pinch Strength (APS), and Oppositional Pinch Strength (OPS); Disabilities of the Arm, Shoulder and Hand (DASH); Patient-Rated Wrist Evaluation (PRWE); Pain Visual Analog Scale (VAS)) 3. Wrist flexion-extension; radioulnar deviation; pronation-supination **Delayed Motion Group**: 1. **Days 1–14: Finger and thumb ROM in splint** 2. Wrist splint or short arm cast until the 5th week 3. **In the 6th week**, AROM, AAROM PRO, M and strengthening are carried out 4. Wrist flexion-extension; radioulnar deviation; pronation-supination	1. The early motion group patients started moving at week two and had better movement, strength, pain control, and outcome scores than the delayed motion group. 2. Wrist movement, as well as DASH scores, PRWE, and VAS pain levels, were significantly different at week 6 3. When comparing pinch strength on the uninvolved side, APS and OPS were significantly different at week 10 4. Early movement in unilateral distal radius post-op patients can be an alternative to faster recovery and return to activities.

(*Continued*)

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Table 2 (Continued).

No	Author, Year, Dan Country	Research Purposes	Research Sample	Types of Research	Orthopedic Surgery Area	Intervention/Procedure	Results
2.	(Eymir et al, 2022)[20]	To compare the effectiveness of Progressive Muscle Relaxation (PMR) accompanied by Standard Physiotherapy (PT) with standard PT during inpatient rehabilitation of Total Knee Arthroplasty (TKA) patients on post-operative outcomes	106 patients with primary TKA 1. **PMR Group**: 55 patients 2. **SR Group**: 51 patients	Prospective randomized controlled trial	Knee	**PMR Group**: 1. **Before surgery**: patient education regarding standard PT and PMR (1 hour) 2. **During the inpatient period**: standard PT (ROM, active assistance, isometric and isotonic strengthening, functional and gait exercises) twice daily (30 minutes) 3. Rest 10 minutes 4. **POD1 - POD3**: PMR training (after standard PT) twice/day (per 30 minutes). PMR therapy according to PMR audio recording instructions ● The patient contracts the muscle for 5 seconds and relaxes it ● The patient relaxes for 10–15 seconds, focusing on the difference in muscle tension and relaxation before exercising the next muscle ● The patient breathes deeply during the procedure ● The patient relaxes all muscles simultaneously (shoulders and neck, right and left hands, arms, chest, stomach, gluteal muscles, thighs, legs, face and forehead) **SR Group**: 1. **Preoperatively**: standard PT-related patient education consisting of one 1 hour individual session (1–2 days before surgery) 2. **During the inpatient period**: Standard PT is administered twice daily for a duration of approximately 30 minutes	1. The PMR group had better effects on pain quality, muscle strength, and kinesiophobia than the SR group 2. The PMR group had higher quadriceps strength and lower levels of kinesiophobia than the SR group 3. PMR therapy can be carried out easily on patients because it is safe and cheap, so that it can be applied as part of post-TKA rehabilitation

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3.	(Argut et al, 2021)[21]	To compare the effectiveness of a combined manual therapy exercise program with an exercise program without the combination of pain, function, ROM, quality of life, and patient satisfaction outcomes.	42 patients with total knee arthroplasty (age 68.45 ± 6.3 Years)	Randomized controlled trial	Knee	The patient must perform the exercises every day (2 sets of 10 repetitions each) and record the completed exercises in an exercise diary. 1. The patient is mobilized early, and the leg is elevated for 15 minutes (5 times daily). 2. The patient has performed ankle pumping exercises on the first day after surgery. 3. The patient performs various positions with exercises, such as supine, knee flexion with active assistance, straight leg raise, knee flexion-extension with active assistance sitting, standing hip and knee flexion, hamstring and calf stretching exercises, gait training, and Functional exercises for transfers and climbing stairs. The exercise is performed in three sets of ten repetitions. 4. The patient follows a home exercise program which includes knee flexion (supine and sitting), straight leg raise, standing hip and knee flexion, and flexibility exercises.	1. Body function and patient satisfaction can be increased, and pain can be minimized significantly through a structured exercise program with a combination of manual therapy consisting of joint and soft tissue mobilization 2. There is an improvement in quality of life and patient satisfaction
4	(Kuru et al, 2020)[11]	To determine the effectiveness of early mobilization on walking ability and reducing pain in geriatric patients after partial prosthesis surgery	52 patients with a mean age of 82.9 ± 6.5 years after hip surgery	Case-control designs (a retrospective analysis)	On the first postoperative day, all bone	1. All patients are asked to bear postoperative day. They are mobilized with full or partial weight bearing. 2. Gait correction is carried out after a hip fracture to restore its function.	1. Length of hospital stay is significantly shorter, walking ability is improved, and venous thrombosis can be reduced in patients who undergo early mobilization and full weight bearing after hip arthroplasty. 2. 69.6% of patients given initial weight-bearing were able to walk with a cane, while 62.1% of weight-bearing patients could only walk with crutches 3. Patients mobilized within the first 24 hours had a mean Harris Hip Score (HHS) value significantly higher than patients who underwent delayed mobilization.
5.	(Zou et al, 2019)[22]	To determine the effectiveness and results of Fast Track Rehabilitation (FTR) for orthopaedic surgery patients	220 patients with post-op upper and lower extremities 1. **Control Group**: 110 patients 2. **Intervention Group:** 110 patients in the FTR intervention group	Randomized controlled trial	Upper and lower extremities	**Control Group**: 1. Traditional anaesthesia 2. Pain management 3. Mobilization is carried out on days 2–4 4. Mobilization is carried out in stages FTR **FTR Intervention Group**: 1. Preoperative educational activities 2. Pain management 3. Post-operative education 4. Early mobilization on the 1–2nd day after surgery → simple to heavier movements. 5. Carry out early mobilization (passive or active ROM) every morning and evening.	1. After the patient underwent early mobilization in the form of FTR, the results showed lower levels of anxiety, pain, nausea and vomiting after 24 hours of surgery. In addition, the length of hospital stay also became shorter after FTR. 2. Early mobilization in the form of FTR can significantly make patients recover more quickly.

(*Continued*)

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Table 2 (Continued).

No	Author, Year, Dan Country	Research Purposes	Research Sample	Types of Research	Orthopedic Surgery Area	Intervention/Procedure	Results
6.	(Ling et al, 2020)[23]	To evaluate the effects of early weight bearing at two weeks post-operatively	53 post-op hallux valgus patients (29 control group patients and 24 early weight-bearing intervention group patients)	Randomized controlled trial	Hallux valgus	According to the protocol, the control group who had undergone surgery had to walk without weights for 6 weeks, then bear partial weights for 6 weeks, and walk with full weights for 12 weeks. Meanwhile, the intervention group who had undergone surgery was not recommended to bear weight for two weeks. Early mobilization was carried out with 10 weeks of partial weight bearing and 12 weeks of full weight bearing.	The results in the intervention group with early weight bearing showed that foot function was better at week 12, minimizing symptoms of stiffness. Daily activities and quality of life were also better.
7	(Wu et al, 2019)[24]	To determine the effectiveness and safety of three types of extremity positions in post-primary TKA patients	135 post-op knee patients (45 people in each group)	Randomized controlled trial	Knee	1. Group A, who had surgery, were given 50-degree hip fixation and 90-degree knee flexion for 6 hours. 2. Group B, who had surgery, was given a hip position elevated 30 degrees and knees flexed 45 degrees for 6 hours. 3. Group C, who had surgery, were given a procedure in the form of a full extension of the operated knee.	1. Total blood loss in groups A and B was lower than in group C. 2. Group A experienced a lower reduction in haemoglobin loss than groups B and C. 3. Knee function was better in group A compared to C 4. ROM scores were better in group A than in B 5. One day after surgery and one month after surgery, group A experienced lower knee swelling than group B 6. Group A patient satisfaction ratings were higher than groups B and C regarding hospital stay time
8	(Klika et al, 2022)[25]	To assess the effectiveness of using Neuromuscular Electrical Stimulation (NMES) to increase quadriceps strength and functional outcomes in post-TKA surgery patients	66 primary TKA patients in the NMES intervention group (44 patients) and control group (22 patients)	Randomized controlled trial	Knee	**NMES Intervention Group**: Patients are instructed to use a device that ranges from 15 to 85 V, depending on patient comfort. The program is in the form of monophasic pulses with a frequency of 50 pps, a pulse width of 5 ms, a duty cycle of 25%, a work cycle of 12 seconds, a relaxation time of 10 seconds, and five cycles. Total relaxation time: rest time (1:1.4 s). **Control Group (Non-NMES)**: The group underwent basic healing and was not given NMES therapy.	1. Post-operative patients with NMES therapy showed greater improvement than patients without NMES therapy at weeks 6 and 12 2. At week 6, the performance of patients with NMES therapy was 3.5 seconds faster, while the performance of patients without NMES therapy was still slower.

Discussion

Early mobilization intervention can quickly restore patients' everyday activities after orthopaedic surgery. The following are early mobilization-based interventions that can be applied to patients after orthopaedic surgery.

Motion-Based Early Mobilization Intervention

Limited Range of Motion (ROM) is one factor that can influence patients' functional status after orthopaedic surgery, such as Total Knee Arthroplasty (TKA). Patient dissatisfaction after limited ROM and post-operative pain caused TKA in 90.6% of patients.[26] Therefore, early strengthening of ROM and modulation of pain can accelerate normal mobilization and reduce the patient's length of stay in the hospital.[21] Rehabilitation carried out by patients after orthopaedic surgery, such as TKA, focuses on reducing pain, restoring the ability to flex by 90 degrees, and ROM with full extension.[27] However, to carry out daily life activities, such as going up or down stairs, at least 110 degrees of flexion is required.

Research results show that pain reduction, increased mobility function, and patient satisfaction are effectively obtained by implementing early mobilization through a combination of a structured exercise program with manual therapy, including joint and soft tissue mobilization.[21] The results of other studies show that early mobilization can significantly reduce the incidence of anxiety, pain, nausea and vomiting after 24 hours of surgery.[22] The hospital stay is shorter after providing early mobilization intervention through movement after rehabilitation.

Other studies say most patients benefit significantly from motion-based early mobilization after surgery.[28] In orthopaedic cases, distal radius fractures are frequent, and fixation is carried out in the form of volar plating. Indications for early mobilization for distal radius fractures include significant radial (>3 mm), extension (beyond neutral), loss of radial inclination (>5 degrees), and articular incongruity or instability.[29] Motion-based early mobilization that can be carried out after surgery includes functional movements, such as flexion-extension, radial, ulnar deviation, and pronation-supination, as well as strengthening movements, such as grip strength, Appositional Pinch Strength (APS) and Oppositional Pinch Strength (OPS)); Disabilities of the Arm, Shoulder and Hand (DASH); Patient-Rated Wrist Evaluation (PRWE); and Pain Visual Analog Scale (VAS).[19]

Motion-based early mobilization carried out on patients requires supervision by health workers, such as nurses or therapists. In the first 14 days after surgery, the patient undergoes ROM on the finger and thumb and then performs functional movements and strengthening movements.[30] By carrying out motion-based early mobilization, patients after orthopaedic surgery can recover their movement within 6 weeks compared to patients without early mobilization, where within 6 weeks, they have just removed the cast and cannot move normally.[19] Other studies show that movement as an early mobilization intervention provides a faster recovery time of 1–2 months.[21] Patient recovery and return to normal activities are faster because early mobilization can improve pain control, outcome scores, and movement.

Early Mobilization Intervention Based on Progressive Muscle Relaxation (PMR)

Progressive Muscle Relaxation (PMR) is the easiest technique given to patients in the form of physical and mental relaxation.[31] PMR intervention is a type of early mobilization after orthopaedic surgery that can reduce anxiety, regulate neuromuscular activity, release muscle tension, and reduce the overall pain sensation because pain stimuli's transmission is blocked and pain perception is changed.[32] One of the orthopaedic cases where PMR can be performed is Total Knee Arthroplasty (TKA).[20] In previous studies, a complementary modality in early mobilization, combining PMR with guided and mental imagery, can improve pain, mobility, and muscle strength in patients with various disorders.[6,11,23]

When carrying out early mobilization in the form of PMR, patients will be advised to carry out standard physiotherapy starting on post-operative day 1 (POD1), which takes place twice daily and lasts 30 minutes.[20] Standard physiotherapy includes active assistance (ROM), isometric and isotonic strengthening exercises, gait training, functional exercises for transfer, and walking. Patients are given rest for 10 minutes before continuing with PMR exercises to prevent the disturbing effects of turning off the lights, not wearing tight clothing, and minimizing the urgency of urinating and defecating.

Early mobilization in the form of PMR is carried out during POD1 to POD3 (around 30 minutes) according to the PMR audio recording instructions that the Psychologists Association has prepared. The audio recording was accompanied by low-pitched background music and the sound of water which was listened to by the patient using an audio

player using headphones in a supine position in bed and performing PMR exercises supervised by a physiotherapist to get used to the intervention.[33] After the PMR activity, the patient will be assessed regarding the level of pain, knee range of motion, and knee oedema (using the Numeric Pain Rating Scale (NPRS) and goniometer); knee strength (using a handheld dynamometer flexing the hip at 90 degrees and knee at 60 degrees); knee function score (using the Hospital for Special Surgery (HSS) knee score); functional activity and walking speed level (using the Iowa Level of Assistance Scale (ILAS) and Timed Up and Go (TUG) test); hospital anxiety and depression scale (using the Hospital Anxiety and Depression Scale (HADS)); and the Tampa Kinesiophobia scale (using the Tampa Scale for Kinesiophobia (TSK)).[20]

In other research, it is said that with the PMR approach, all anxiety and depression experienced by patients will experience modulation of neurosympathetic and neuroendocrine responses.[34] PMR activities with standard physiotherapy can provide better short-term effects on pain, kinesiophobia, and muscle strength compared to standard physiotherapy. Therefore, PMR can be easily implemented as part of patient rehabilitation after TKA surgery because it uses a simple technique that is easy for patients to carry out and is safe and cheap.

Weight Bearing-Based Early Mobilization Intervention

Lower extremity fracture sufferers can undergo surgical or non-operative treatment based on the level of fracture experienced. Based on the principles of handling orthopaedic cases according to the Arbeitsgemeinschaft für Osteosynthesefragen guideline, in fracture conditions that require surgery, standard post-operative care is usually given, including non-weight-bearing and immobilization for six weeks.[35] Research regarding the feasibility of early weight-bearing has been carried out in recent years in fracture cases undergoing surgery. Weight-bearing is placing body weight on the injured leg. Early weight-bearing (EWB) or Permissive Weight-Bearing (PWB) is carried out by instructing the patient to apply weight-bearing according to the patient's tolerance to accelerate union and increase bone strength.[11]

The EWB action is carried out without limiting the percentage of body weight but uses indicators for the appearance of clinical symptoms, such as pain or swelling. Based on standards, immobilization or non-weight bearing must be done for six weeks. However, early mobilization with non-weight bearing two weeks after surgery provides better results 12 weeks after surgery, such as reducing stiffness and pain and improving general function and activity. Daily life and quality of life.[23] This is in accordance with other studies showing that non-weight bearing interventions can provide effective results if carried out two weeks after surgery, then given partial loading for 10 weeks and full loading for 12 weeks.[36]

Positioning-Based Early Mobilization Intervention

Post-operative positioning-based early mobilization of the knee limb is a simple and cost-effective intervention to prevent excess blood loss and increase range of motion. Early healing and increasing range of motion are important points in post-operative patients because they can reduce swelling in the knee. There is research that shows by comparing three different positions, namely in group A, 50 degrees of hip flexion and 90 degrees of knee flexion for six hours after surgery, in group B, 30 degrees of flexion and 45 degrees of knee flexion for six hours after surgery, and in group C The operated knees were straightened after surgery. The results showed that group A was better than groups B and C.[37]

Another study showed that post-orthopaedic surgery patients who underwent positioning could significantly minimize total and hidden blood loss, drain volume, and haemoglobin.[38] This is because TKA management with post-operative flexion has been proven to increase the patient's range of motion and prevent excessive post-operative blood loss. This is in accordance with other research, which states that positioning can also improve knee range of motion function, speed up post-operative return time, reduce knee swelling one day after surgery, and increase patient satisfaction.[39]

Early Mobilization Intervention Based on Neuromuscular Electrical Stimulation Application

Electrical stimulation, known as Neuromuscular Electrical Stimulation (NMES), applies electrical stimulation to the percutaneous periphery, which can produce skeletal muscle contractions.[25] The aim of NMES is to strengthen muscles, especially in conditions of long immobilization, maintain muscle mass, and train muscles selectively. The NMES therapy system is controlled by a home-based application, a convenient device combining digital health technology with home-

based NMES clinical rehabilitation technology. When installed with NMES, patient-reported outcomes are the patient's pain and activity levels, which are sent to the cloud portal for review by the provider. Patients use the device for one-week post-surgery and continue for up to 12 weeks.

The results of another study showed that TKA patients using NMES could increase quadriceps strength, as evidenced by a 13% increase in quadriceps strength post-operatively in the first three weeks.[40] Patients using NMES had a lower mean length of stay of 1.79 days. Research reports that the use of NMES can significantly increase quadriceps muscle strength.[41] Another different study in which post-TKA patients showed no difference in changes in ROM after using NMES.[42] These results are based on other studies that show no significant differences in knee flexion or extension in patients treated with NMES at six weeks or six months post-operatively.[43] This is due to the need for consistency in carrying out other early mobilization interventions to obtain optimal results.

Implications for Multidisciplinary Practice and Future Research

Early mobilization intervention in post-orthopedic surgery patients has many benefits to accelerate the recovery process. In implementing comprehensive interventions, a coordinated multidisciplinary practice approach is certainly needed from various health care providers, such as orthopedic surgeons, nurses, physiotherapists, nutritionists, and others. All health care providers need to implement health team collaboration in designing a care plan that focuses on appropriate early mobilization intervention for post-orthopedic surgery patients. Every health worker has an important role in the success of the early mobilization intervention process in patients.

Doctors together with nurses and physiotherapists can collaborate to determine and implement early mobilization techniques that are appropriate to the patient's condition, especially nurses as providers of nursing care can also always monitor the patient's condition and nutritionists can help the recovery process through appropriate nutritional intake. In addition, all health workers also need to collaborate to manage the pain of patients after orthopedic surgery effectively so that early mobilization interventions can be implemented optimally. That way, multidisciplinary collaboration related to early mobilization interventions for patients after orthopedic surgery can accelerate the return of muscle function in patients and minimize symptoms felt after surgery.

Currently, research focusing on the effectiveness of various types of early mobilization interventions in post-orthopedic surgery patients is still very limited. Therefore, multidisciplinary collaboration needs to be implemented optimally. Thus, for further research, the author suggests that researchers can increase the number of participants and reach more post-orthopedic surgery patients due to fractures in the extremity and non-extremity areas so that a broader review can be conducted using the meta-analysis method.

Strengths and Limitations

This scoping review has strengths and limitations. First, this article has yet to be able to integrate the results through meta-analysis due to the limited data presented from the included studies. Second, this review only used a systematic search of four major databases because specific research articles related to early mobilization interventions in post-orthopaedic surgery patients due to extremity fractures are pretty rare, so the scope is limited. Third, regarding the sample size, we did not include studies with a minimum number of patients because existing research articles related to the topic are very limited. However, the critical appraisal analysis results with JBI showed >75% for all studies analyzed.

Conclusion

Early mobilization benefits patients after orthopaedic surgery by increasing the range of motion, reducing pain, and reducing hospital stay. Early mobilization interventions that can be applied include motion interventions, which have the fastest recovery time, namely six weeks after surgery; PMR interventions, which can reduce pain and increase the effects of muscle strength and kinesiophobia in the short term; weight-bearing interventions which can reduce stiffness and pain as well as improving quality of life and daily activities in the 12 weeks post-surgery, positioning interventions that can reduce post-operative blood loss and increase patient range of motion, as well as NMES interventions for patients who receive prolonged immobilization to increase muscle strengthening. Of the five interventions, motion-based early mobilization and PMR showed better results than other interventions as seen from the faster recovery time to range of

motion, namely six weeks after surgery. In addition, both interventions are easy to implement as part of safe and inexpensive patient rehabilitation because the techniques used are simple.

Nurses and other healthcare providers can utilize the results of this literature review as additional information to assess and follow training related to how to provide early mobilization interventions that are appropriate for post-orthopaedic surgery patients. Nurses, as providers of nursing care, are expected to be able to implement one of the early mobilization interventions for patients after orthopaedic surgery to accelerate the return of the patient's muscle function and minimize the symptoms felt after surgery. Early mobilization in post-orthopaedic surgery patients can benefit for hospitals by shortening recovery time and hospitalization. As for further research, it is hoped that it can further improve the results of specific studies related to other effective early mobilization interventions for post-orthopedic surgery patients and a broader review can be carried out using the meta-analysis method for maximum results.

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Disclosure

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