

Research Paper

Development of Physical Therapy Home-based Rehabilitation Protocol Following Hip Fracture Surgery: A Delphi Study



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Citation Jitmal R, Vongsirinavarat M, Kunanusornchai W, Leelahavarong P, Pramuksun P. Development of Physical Therapy Home-based Rehabilitation Protocol Following Hip Fracture Surgery: A Delphi Study. *Iranian Rehabilitation Journal*. 2026; 24(3):311-320. <http://dx.doi.org/10.32598/irj.24.3.4>

<http://dx.doi.org/10.32598/irj.24.3.4>

Article info:

Received: 08 Feb 2026

Revised: 23 May 2026

Accepted: 08 Jun 2026

Keywords:

Home-based rehabilitation, Hip fracture surgery, Delphi study, elderly, Physical therapy

ABSTRACT

Objectives: This study aimed to develop the therapy protocol based on the international classification of functioning, disability and health framework for home-based rehabilitation following hip fracture surgery.

Methods: A three-round Delphi study was conducted. Eight health professionals involved in hip fracture care were recruited. They were asked to score and provide recommendations regarding home-based rehabilitation following hip fracture surgery. Agreement was considered at least 75%.

Results: Eight experts completed three Delphi rounds. After iterative revisions, all retained components achieved $\geq 75\%$ consensus, with agreement ranging from 87.5% to 100%. Several key components reached 100% agreement. No significant differences were observed between the second and third rounds ($P > 0.05$), indicating response stability. The final protocol included domains of knowledge, assessment, exercise training, functional mobility, and education.

Discussion: This study developed a home-based physical therapy rehabilitation protocol following hip fracture surgery. This protocol was developed by consensus among health professionals and included all important domains in hip fracture rehabilitation.

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Highlights

- This study establishes health professionals' consensus on a home-based rehabilitation protocol following hip fracture.
- This study highlights the home-based rehabilitation protocol following hip fracture that was developed based on the International Classification of Functioning, Disability and Health framework.
- The implementation of this protocol can contribute to a more holistic and well-rounded approach to addressing postoperative issues in patients undergoing hip-fracture surgery.

Plain Language Summary

This study developed a clear home-based physical therapy program for patients after hip fracture surgery. Health professionals agreed on key components, including assessment, progressive strengthening, balance and weight-bearing exercises, functional mobility training, and patient education. The protocol aims to support safe recovery and improved daily function at home.

Introduction

The incidence of hip fracture is increasing and has become an important public health issue in an aging society worldwide [1, 2]. The predicted number of patients with hip fracture will significantly increase to 6.26 million in 2050 [2]. This increase is driven by aging, gender, and comorbidity [1]. Several complications, including delirium, urinary tract infection, pressure ulcers, and deep vein thrombosis, can occur after hip fractures [3-5]. This issue is not only an individual health problem, but also a public economic problem [6].

Although surgery is the gold standard for treating hip fracture, all patients require rehabilitation after treatment to return to function and control morbidity and mortality. During hospitalization, most patients receive postoperative rehabilitation, including early mobilization, functional training, and strength and balance exercises. However, some patients cannot reach their pre-fracture status before discharge because of the limited length of hospital stay [7]. Thus, the rehabilitation program should continue after discharge. Facility-based, community-based, and home-based rehabilitation following hip fracture surgery play a crucial role in this recovery phase. Since the major problem for hip fracture patients is dependent ambulation, home-based rehabilitation delivered to their home is recommended to improve their real-life function [6]. Previous studies have demonstrated that these patients' function and quality of life improve after receiving home-based rehabilitation [8]. In addition, the Academy of Orthopedic Physical Therapy and the Academy

of Geriatric Physical Therapy of the [American Physical Therapy Association \(APTA\)](#) have stated that key recommendations for hip fracture rehabilitation include progressive strengthening exercises, weight-bearing training, balance training, and functional training. Although these rehabilitation domains are established, no standardized protocols exist for post-operative rehabilitation following hip fracture surgery, particularly regarding the details of the rehabilitation prescription [7].

According to the international classification of functioning, disability and health (ICF) framework, a holistic approach to individual patients' functional and disability status should be considered. The ICF viewpoint addresses body structure impairment, activity limitations, participation restrictions, and personal and environmental factors [9]. However, most of the hip fracture rehabilitation protocols emphasize body structure or activity limitation [10, 11]. Personal and environmental factors are often overlooked in post-operative rehabilitation interventions. In addition, a successful rehabilitation strategy should consider personal and environmental factors that influence patient recovery, including comorbidities management, medication, home environmental management, and caregiver training in the rehabilitation protocol [12].

Therefore, this study aimed to develop the physical therapy protocol based on the ICF framework for home-based rehabilitation following hip fracture surgery.

Materials and Methods

Study design

The Delphi consensus method was used to develop a physical therapy home-based rehabilitation protocol. The initial home-based rehabilitation protocol was drafted based on a literature review. The evaluation and interventions were then categorized into ICF domains. Eventually, three rounds of consensus on the physical therapy home-based rehabilitation protocol following hip fracture surgery were performed by the expert panels.

Expert panelists

The inclusion criteria for expert panelists required at least five years of health professional experience in managing and caring for patients with hip fractures. The panel consists of eight healthcare professionals, including two orthopedic surgeons, two physiatrists, and four physical therapists. These experts had more than five years of clinical experience in hip fracture management (Table 1). They received the study details and provided informed consent before participating.

The first Delphi round

Two physical therapists developed the initial draft of the home-based physical therapy rehabilitation protocol based on a comprehensive literature review. The review involved a systematic search using the following keywords: “hip fractures,” “rehabilitation,” “home-based rehabilitation,” “multidisciplinary,” and “home environment adjustment.” All relevant articles were critically appraised and used to inform protocol development. The protocol comprises fundamental knowledge, assessment

of body functions and structures, evaluation of activity limitations, assessment of health-related quality of life, environmental assessment, and rehabilitation and educational components. Finally, the completed draft protocol was sent to an expert panel for review. The experts were asked to read the full protocol and rate each component using an online questionnaire that included all protocol topics. Each item was scored on a nine-point Likert scale (1=not essential, 9=very essential), and additional comments for each section and for the overall protocol were encouraged.

The second Delphi round

In the second round, the percentages of agreement from the first round were presented. Elements that experts agreed on inconsistently were finalized using a dichotomous answer (essential/not essential). Additionally, the protocol summarized comments and suggestions from the first round by domain. The experts were then asked to confirm whether the suggestions were appropriate for inclusion in the protocol. In this round, elements and suggestions with more than 75% agreement were included in the protocol [13].

The third Delphi round

In the final round, the protocol was revised based on feedback from the second round. Then, the experts were asked to re-evaluate the appropriateness of the elements in the protocol. Items that reached consensus (at least 75% agreement) were kept in the protocol [13]. Finally, the physical therapy home-based rehabilitation protocol following hip fracture surgery was completed in this round. Figure 1 shows the overall Delphi process.

Table 1. Working experience and place of expert panelists

Expert Panelists		Working Experience (y)	Working Place
Orthopedic surgeons	1 st	27	University hospital
	2 nd	15	Secondary hospital
Physiatrists	1 st	10	Tertiary hospital
	2 nd	5	Tertiary hospital
Physical therapists	1 st	32	Tertiary hospital
	2 nd	26	Community hospital
	3 rd	7	University hospital
	4 th	11	Private clinic

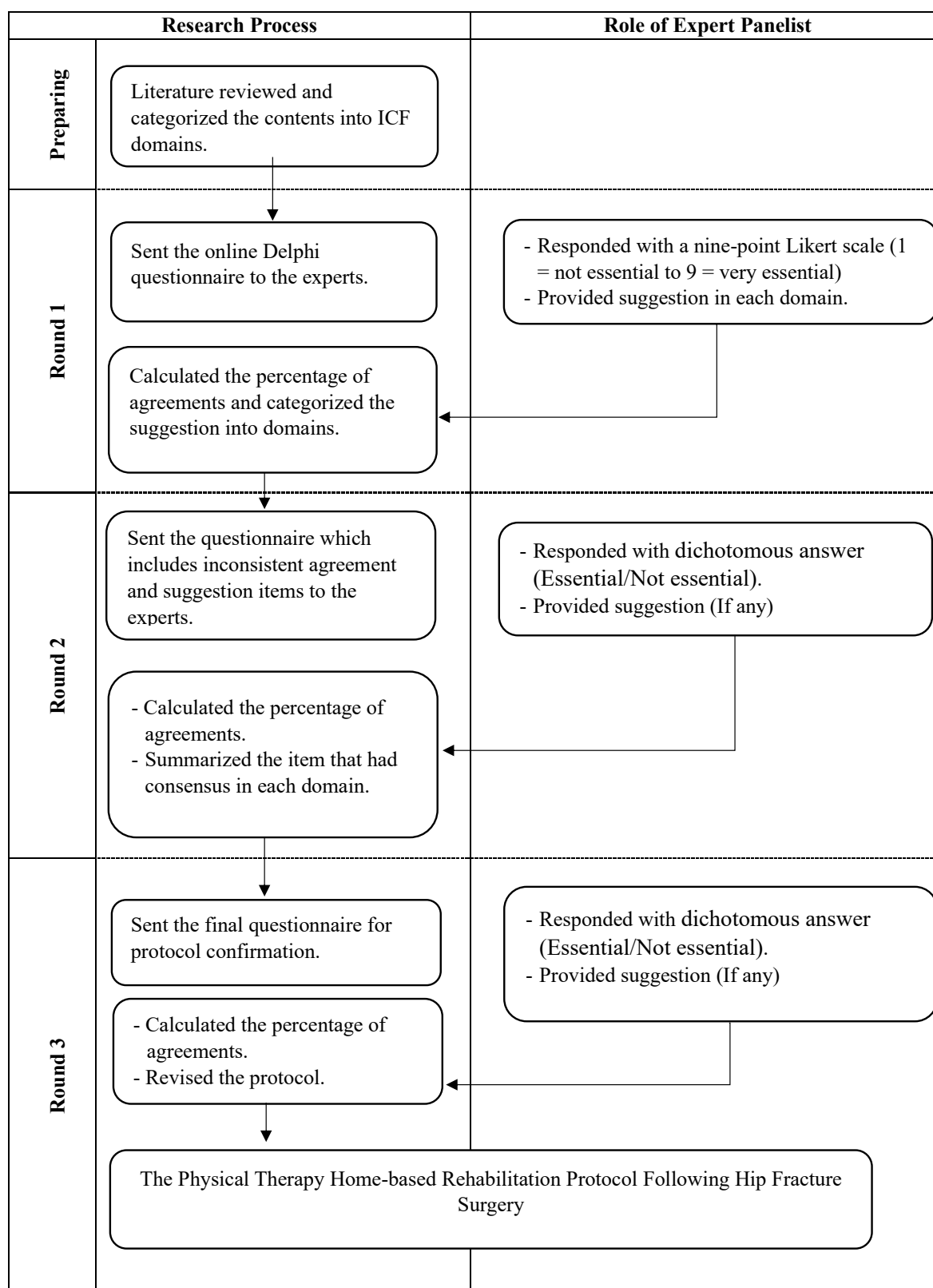


Figure 1. Overall study process

ICF: International classification of functioning, disability and health.

Statistical analysis

Descriptive statistics were used to summarize the representative results, including the characteristics of the expert panelists, using SPSS software, version 23 (Armonk, NY, USA). For the Delphi process in rounds 2 and 3, the percentage of agreement was calculated by dividing the number of experts who rated an item as “essential” by the total number of experts. Consensus was defined as a minimum agreement level of 75% among the experts [13]. To assess the stability of responses between rounds 2 and 3, the exact McNemar’s test was applied due to the small sample size of experts. A non-significant result ($P>0.05$) was interpreted as indicating response stability [14].

Results

Expert panelists

Table 2 presents the characteristics of eight participants in the Delphi consensus process. Three professional areas, including orthopedic surgeons, physiatrists, and physical therapists, were included to ensure the breadth and depth of expertise regarding hip fracture management.

Delphi results

In the first round, the expert panelists disagreed with 14 components. Additionally, they suggested components consisting of 4 items of basic knowledge, 5 items of body functions and structures evaluation, 4 items of activity limitation evaluation, 3 items of health-related

quality of life assessments, 4 items of environmental assessments, 13 items of rehabilitation programs, and 3 items of educational programs. These components were included in the second round.

In the second round, the osteoporosis management component in the basic knowledge domain was eliminated since it did not reach 75% agreement. For assessment and evaluation, range of motion, muscle length, time up and go test, Barthel index, and weight-bearing status did not reach consensus. Moreover, the high-level skill training activities, including forward lunge, standing heel raise, core stabilizer muscle training, and stair climbing were also removed from the protocol.

In the final round, the protocol was revised based on the results from the second round and then sent to expert panelists for final consideration. Finally, Table 3 presents the physical therapy home-based rehabilitation protocol following hip fracture surgery.

Stability and agreement

The physical therapy home-based rehabilitation protocol following hip fracture surgery achieved a consensus level greater than 75% across all retained components. The following components reached 100% agreement among the experts: basic knowledge, health-related quality of life assessment, cognitive level assessment, anxiety and depression assessment, environmental hazard evaluation, progressive strengthening exercises, deep vein thrombosis education, medication education, activities of daily living and mobility education, complication monitoring, and home environment adjustment.

Table 2. Expert panelists characteristics

Characteristic		No./Mean±SD
Sex (male/female)		3/5
Age (y)		43.25±9.04
Clinical experience in hip fracture (y)		16.63±10.27
Professional area	Orthopedic surgeons	2
	Physiatrists	2
	Physical therapists	4
Education level	Bachelor	3
	Master	3
	PhD	2

Table 3. Physical therapy home-based rehabilitation protocol following hip fracture surgery: Percentage of agreement and stability analysis using the exact McNemar's test

Domains	Protocol Contents	Agreement (%)	P*	
Basic knowledge	Must know the basic knowledge, including hip fracture classification, types of hip fracture treatment, precautions and contraindications for mobility as well as secondary fall prevention.	100	1.000	
Assessments	Body structure	Assess pain level, lower extremity strength, and body posture that might relate to falls.	85.7	0.500
	Activity limitation	Evaluate activity in daily life, especially ambulation activity, using gait speed, CAS, or daily activity observation.	85.7	0.250
	Health-related quality of life	Evaluate quality of life using the SF-36 or EuroQol-5 dimensions scale.	100	0.500
	Cognitive level	Evaluate cognitive level using the MMSE or MoCA.	100	1.000
	Anxiety and depression	Have to evaluate anxiety and depression levels after hip fracture. The PHQ-9 might be performed for screening.	100	0.500
	Environmental hazard	Assess the safety of the environment that surrounds the patient’s daily activity area. It should minimize the risk of falls.	100	1.000
Progressive strengthening exercises	Target muscle groups include the hip abductors, hip extensors, and knee extensors. Training should begin in a supine position or with non-weight-bearing exercises, progressing to standing or weight-bearing on the lower extremity. The resistance, such as a sandbag or resistance band, should be applied according to the patient’s potential.	100	1.000	
Weight-bearing and balance training exercises	Training activities should progress from basic to advanced by changing direction and position or decreasing the base of support. Training may be prescribed as standing balance, marching, sideways stepping, and forward stepping, respectively.	87.5	0.500	
Functional mobility training	Functional mobility activities should match the patient’s daily needs, including sitting from supine, sitting to stand, walking, and transferring to a wheelchair.	87.5	0.250	
Education program	Delirium	Advise caregivers to help remind and stimulate the patient’s awareness, such as by asking and answering questions about names of places, time, and persons. Suggest drinking an adequate amount of water each day.	87.5	1.000
	Deep vein thrombosis	Advise elevating the legs to 20–30 degrees and encourage leg movements by flexing and pointing the toes while in bed.	100	1.000
	Medications	Provide adverse effect information if the patient uses sedative and antipsychotic drugs related to falls.	100	1.000
	Activity in daily living and mobility	Encourage and support patients in daily activities as much as possible (depending on pre-fracture level of independence). Additionally, the patient must walk at least 50-100 meters 3 times/week.	100	1.000
	Complication monitoring	Monitoring for complications and changes in the patient’s condition, such as coughing, phlegm, fever, leg swelling, or deformity.	100	1.000
	Home environment	Suggest that the walkway distance be sufficient for daily activity and that obstacles be eliminated.	100	1.000

Abbreviation: CAS: Cumulative ambulation score; SF-36: Short-form health survey; MMSE: Mini-mental state examination; MoCA: Montreal cognitive assessment; PHQ-9: Patient health questionnaire-9.

*Tested by exact McNemar's test.

The remaining components—body structure and activity limitation assessment, weight-bearing and balance training exercises, functional mobility training, and delirium management—achieved 87.5% agreement.

Stability between the second and third Delphi rounds was assessed using the exact McNemar's test. No statistically significant differences were observed between rounds for any component ($P > 0.05$), indicating stability of expert responses.

Discussion

This study aimed to develop physical therapy practice guidelines for home-based rehabilitation following hip fracture surgery. This is the first protocol developed based on the ICF model, which includes not only assessment and evaluation but also interventions. The final guideline consists of six domains: basic knowledge, assessments, progressive strength training, weight-bearing and balance training, functional mobility training, and educational programs. This protocol could be beneficial for home-based rehabilitation prescription after hip fracture.

First, the expert panel considered basic knowledge essential for physical therapists. A previous study found that approximately 6% of patients had dislocations after hip fractures [15], which was related to an increase in mortality rate [16]. Similarly, secondary falls after hip fracture occurred in 28% of those with a hip fracture history, and 5% of them had a new hip fracture [17]. Therefore, physical therapists must know the precautions and contraindications for hip mobility by surgery types, as well as secondary fall-prevention strategies.

For the assessment, several aspects were structured based on the ICF domains. The consequences after hip fracture include mobility problems, psychological problems, and decreased quality of life [18-21]. Pain and lower-extremity strength are major issues commonly addressed in the body structure domain. However, body posture should also be highlighted in the assessment. In previous studies, awkward posture, such as a stooped position, was associated with fall incidence [22]. For the activity limitation domain, ambulation was the key problem. Gait speed was an indicator useful for predicting walking ability after hip fracture [23]. Decreased mobility can induce complications, including pneumonia, delirium, or deep vein thrombosis [24]. After hip fracture, 23% of patients had anxiety or depression, and 41.8% of patients had cognitive impairment, which were important barriers to recovery [25, 26]. More than half of patients

had decreased quality of life [7]. It should be evaluated between pre- and post-rehabilitation to assess the value and success of rehabilitation. Additionally, not only personal factors or performance must be considered, but environmental factors also play a crucial role. Those who live in inappropriate home environments have a higher chance of recurrent falls [27]. This problem needs to be addressed and managed to enhance recovery [12].

This protocol included three aspects of rehabilitation training. Progressive strengthening exercises for lower extremity muscles could improve mobility, activities of daily living, balance, lower-extremity strength, and functional outcomes [28-30]. In addition, asymmetrical weight bearing is a common characteristic in patients after hip fracture surgery [31]. Therefore, exercise emphasizing weight-bearing and balance training are a strategy to solve this problem. These specific trainings after hip fracture surgery could evidently improve activities of daily living, functional tasks, as well as quality of life [30]. Functional training was also an intervention that improved recovery outcomes after hip fracture. Previous studies found that functional training, such as standing from a chair, indoor walking, or daily activities, significantly improved recovery outcomes and quality of life of these patients [33, 34].

Besides mobility or ambulation issues, several complications, such as delirium, deep vein thrombosis, pneumonia, and recurrent falls, could also occur after hip fracture. This protocol includes preventive strategies for these complications. Similarly, another study recommended including complication-prevention education in the rehabilitation program to reduce complications and improve outcomes [35].

Although holistic interventions play a crucial role in improving recovery outcomes following hip fracture, no protocol has been proposed that included all of them. This study was the first protocol to include all important domains for home-based rehabilitation following hip fracture surgery. Moreover, it was developed by a skilled multidisciplinary team. Nevertheless, our study had some limitations. First, this protocol might not be appropriate for patients with specific underlying conditions, such as dementia or Alzheimer's disease. Second, half of the expert panelists were medical doctors, i.e., orthopedic surgeons or physiatrists, so they might not be specific in some details of the physical therapy practice. However, the criteria for expert panelist selection were based on practical context in Thailand, and all of them had extensive experience as members of the hip fracture management team. Finally, although a home-based rehabilitation

protocol after hip fracture surgery has the potential to reduce indirect costs related to transportation and caregiver burden, no health economic evaluation has been conducted. In addition, this protocol has not yet been implemented in real-world clinical settings. Therefore, its feasibility and clinical effectiveness remain unestablished. Future studies incorporating health economic evaluation, feasibility assessment, and clinical effectiveness testing are warranted to further validate this protocol.

Conclusion

This study successfully developed a home-based physical therapy rehabilitation protocol following hip fracture surgery. It provides the protocol for assessment and rehabilitation based on the ICF model. However, further study should investigate the feasibility and the effectiveness of this protocol.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Mahidol University Central Institutional Review Board, Bangkok, Thailand (Code: MU-CIRB 2025/107.0304).

Funding

This work was supported by the 60th Year Supreme Reign of His Majesty King Bhumibol Adulyadej Scholarship (Academic Year 2022), granted by the Faculty of Graduate Studies, Mahidol University.

Authors' contributions

Conceptualization, methodology, investigation, and resources: Rapeepat Jitmal and Mantana Vongsirinavarat; Formal analysis and data collection: Rapeepat Jitmal; Writing the original draft: Rapeepat Jitmal; Supervision, review, and editing: Mantana Vongsirinavarat, Wanlop Kunanusornchai, Pattara Leelahavarong, and Piyaporn Pramuksun.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors thank all health professionals who participated in the Delphi study for their valuable time, expertise, and constructive feedback. Their contributions were essential to developing the home-based physical therapy protocol.

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