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Physical Therapy Management of Older Adults With Hip Fracture

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Academy of Orthopaedic Physical Therapy and the Academy of Geriatric Physical Therapy of the American Physical Therapy Association

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Summary of Recommendations*

ACROSS THE ENTIRE EPISODE OF CARE

Examination – Outcome Measures: Body Functions and Structures/Physical Impairment Measures

A Physical therapists must test and document knee extension strength across all settings.

Examination – Outcome Measures: Body Functions and Structures/Self-reported Measures

A Physical therapists must administer and document the verbal rating (ranking) scale for pain in all settings to monitor pain.

Examination – Outcome Measures: Activity Limitations/Physical Performance Measures

A Physical therapists should use the gait speed test in all settings when patients do not require human assistance to walk. Documentation should include the features of test administration: comfortable or maximum speed, walking aid, and rolling start or static start.

A Physical therapists should use the Cumulated Ambulation Score in the acute and postacute clinical settings to measure basic mobility until independent ambulation has been reached.

A Physical therapists should use the timed up-and-go test in all settings to measure mobility and risk for falls when patients do not require human assistance. Documentation should include the features of test administration: comfortable or maximum speed and walking-aid use.

C Physical therapists may use the Short Physical Performance Battery in all settings, though completion may not be feasible in the early postoperative period, depending on ability.

Examination – Outcome Measures: Activity Limitations/Self-reported Measures

B Physical therapists should use the New Mobility Score in the early period/inpatient setting to assess prefracture status, and in the postacute and community settings to assess current status and recovery of prefracture status.

B Physical therapists in all settings should use the Falls Efficacy Scale-International to measure concern about falling.

C Physical therapists may use the Activity Measure for Post-Acute Care in all settings.

C Physical therapists may use the 3-level version of the EuroQol-5 dimensions scale in all settings to measure health-related quality of life.

C Physical therapists may use the 10-item physical functioning scale of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) to measure physical functioning in all settings.

C Physical therapists may use the SF-36 in all settings to measure health-related quality of life.

POSTACUTE PERIOD: POSTACUTE SKILLED-NURSING AND COMMUNITY SETTINGS

Examination – Outcome Measures: Body Functions and Structures/Physical Impairment Measures

B Physical therapists should test and document hip extensor and abductor muscle strength in postacute clinical settings.

Examination – Outcome Measures: Activity Limitations/Physical Performance Measures

B Physical therapists should conduct and document the 5-times sit-to-stand or 30-second sit-to-stand test in postacute inpatient, home, and outpatient settings to measure mobility and fall risk.

B Physical therapists should use the 6-minute walk test in postacute inpatient and community settings when the patient does not require the therapist's physical assistance to walk and when there is an adequate length of corridor to conduct the test.

C Physical therapists may use the Functional Independence Measure in postacute inpatient settings if they have been trained and have a license to use this measure.

C Physical therapists may use the de Morton Mobility Index in postacute inpatient and outpatient settings.

ACROSS THE ENTIRE EPISODE OF CARE

Interprofessional Management – Prevention and Identification of Delirium

A Physical therapists should participate in multicomponent nonpharmacological intervention programs delivered by an interprofessional team (including physicians, nurses, and possibly other health care professionals) for the entire hospitalization for at-risk older adults undergoing surgery to prevent delirium.

Interprofessional Management – Pain Assessment and Management

F Physical therapists must assess hip fracture–related pain at rest and during activity (eg, walking) and implement strategies to minimize the patient's pain during the treatment session to optimize the patient's mobility. Strategies may include appropriate timing of medication, consultation with the interprofessional team, and psychologically informed physical therapy approaches for nonpharmacological pain management.

Interprofessional Management – Prevention of Pressure Ulcers

F Clinicians must screen for risk of pressure ulcers. Risk factors include significantly limited mobility, significant loss of sensation, a previous or current pressure ulcer, nutritional deficiency, the inability to reposition themselves, incontinence, and significant cognitive impairment.

Interprofessional Management – Prevention of Falls

A Physical therapists must assess and document patient risk factors for falls and contribute to interprofessional management. Physical therapists should use published recommendations from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association to guide fall-risk management in patients with hip fracture to assess and manage fall risk.

Interprofessional Management – Secondary Fracture Prevention

F Physical therapists should contribute to interprofessional care to ensure that older adults with hip fracture are appropriately evaluated and treated for osteoporosis and risk of future fractures.

Interprofessional Management – Determination and Communication of Functional Assistance Requirements

F Physical therapists must provide guidance to the interprofessional team and patients on assistive devices and assistance level for transfers and ambulation for patients with hip fracture.

Interprofessional Management – Identification of Individual Goals

F Physical therapists must elicit individual goals for recovery of function, which may include independent basic mobility, achieving prior level of function, return to prefracture residence, and activities to support long-term well-being. Goals should be reviewed and revised throughout the continuum of care.

Interprofessional Management – Transition of Care From the Inpatient Setting

F Physical therapists should work collaboratively to contribute to interprofessional assessment and plan to ensure safe transfer from the hospital to the community. After transfer of care from the hospital, people with continued impairments and functional deficits after hip fracture (including people in nursing homes) should receive evaluation within 72 hours by the facility or home care physical therapist.

Interventions – Structured Exercise

A Physical therapists must provide structured exercise, including progressive high-intensity resistive strength, balance, weight bearing, and functional mobility training, to older adults after hip fracture.

B Clinicians should provide physical therapy/rehabilitation to patients with mild to moderate dementia, using similar interventions and prescriptions as for those without dementia.

EARLY POSTOPERATIVE PERIOD: INPATIENT SETTING

Interprofessional Rehabilitation Programs

A Older adults with hip fracture should be treated in a multidisciplinary orthogeriatric program, which includes physical therapy and early mobilization.

Interventions – Frequency of Physical Therapy

B Patients should be offered high-frequency (daily) in-hospital physical therapy following surgery for a hip fracture, with duration as tolerated, including instruction in a home program.

Interventions – Early Assisted Transfers and Ambulation

A Clinicians must provide assisted transfer out of bed and ambulation as soon as possible after hip fracture surgery and at least daily thereafter, unless contraindicated for medical or surgical reasons.

Interventions – Aerobic Exercise Added to Structured Exercise

C Physical therapists may provide upper-body aerobic training in addition to progressive resistive, balance, and mobility training in the early postacute period (inpatient setting) for older adults after hip fracture.

Interventions – Electrical Stimulation for Quadriceps Strengthening

C Physical therapists may use electrical stimulation for quadriceps strengthening if other approaches have not been effective.

Interventions – Electrical Stimulation for Pain Management

C Physical therapists may use electrical stimulation for pain if it is not sufficiently managed with usual strategies.

POSTACUTE PERIOD: HOME CARE AND COMMUNITY SETTINGS

Interventions – Extended Exercise

A Clinicians must provide opportunities for additional therapies if strength, balance, and functional deficits remain beyond 8 to 16 weeks after fracture. The additional therapies should include strength, balance, functional, and gait training to address existing impairments and activity limitations and fall risk. They may include outpatient services, progressive home exercise programs, or evidence-based community exercise programs such as those identified by the US Centers for Disease Control and Prevention and the National Council on Aging.

Interventions – Physical Activity Interventions

A Physical therapists must provide recommendations to patients to maximize safe physical activity.

C Physical therapists may provide aerobic training in addition to progressive resistive, balance, and mobility training in the community setting for older adults after hip fracture.

*The intervention recommendations are based on the scientific literature published through June 2020. Outcome measures recommendations are based on the literature published through May 2019.

List of Abbreviations

5TSS: 5-times sit-to-stand test
6MWT: 6-minute walk test
AAOS: American Academy of Orthopaedic Surgeons
ADL: activities of daily living
AGREE II: Appraisal of Guidelines for Research & Evaluation II instrument
AM-PAC: Activity Measure for Postacute Care
APTA: American Physical Therapy Association
BMD: bone mineral density
BMI: body mass index
CAS: Cumulated Ambulation Score
CI: confidence interval
CPG: clinical practice guideline
DEMMI: de Morton Mobility Index
DHHS: Department of Health and Human Services
EDGE: Evaluation Database to Guide Effectiveness
EQ-5D-3L: 3-level version of the EuroQol-5 dimensions scale
ES: effect size
FES-I: Falls Efficacy Scale-International
FIM: Functional Independence Measure
GDT: guideline development team
HRQoL: health-related quality of life
ICC: intraclass correlation coefficient
ICD-10: International Classification of Diseases, 10th revision
ICF: International Classification of Functioning, Disability and Health
JOSPT: *Journal of Orthopaedic & Sports Physical Therapy*
MCID: minimal clinically important difference
MCS: mental component summary
MDC: minimum detectable change
NMS: New Mobility Score
OR: odds ratio
PCS: physical component summary
PF-10: 10-item physical functioning scale of the SF-36
RCT: randomized controlled trial
RM: repetition maximum
RR: relative risk
SD: standard deviation
SEM: standard error of measurement
SF-36: Medical Outcomes Study 36-Item Short-Form Health Survey
SMD: standardized mean difference
SPPB: Short Physical Performance Battery
TENS: transcutaneous electrical nerve stimulation
TUG: timed up and go
VAS: visual analog scale
VRS: verbal rating (ranking) scale
WHO: World Health Organization

Introduction

AIM OF THE GUIDELINES

The Academy of Orthopaedic Physical Therapy of the American Physical Therapy Association (APTA) has an ongoing effort to create evidence-based clinical practice guidelines (CPGs) for orthopaedic physical therapy management of patients with musculoskeletal impairments described in the World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF).[273] The purposes of these clinical guidelines are to:

- Describe evidence-based physical therapy practice, including diagnosis, prognosis, intervention, and assessment of outcome, for musculoskeletal disorders commonly managed by orthopaedic physical therapists
- Classify and define common musculoskeletal conditions using the WHO terminology related to impairments of body function and body structure, activity limitations, and participation restrictions
- Identify interventions supported by current best evidence to address impairments of body function and structure, activity limitations, and participation restrictions associated with common musculoskeletal conditions
- Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure, as well as in activity and participation of the individual
- Provide a description to policy makers, using internationally accepted terminology, of the practice of orthopaedic physical therapists
- Provide information for payers and claims reviewers regarding the practice of orthopaedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopaedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents, and fellows regarding the best current practice of orthopaedic physical therapy

STATEMENT OF INTENT

These guidelines are not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual patient and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgment regarding a particular clinical procedure or treatment plan must be made based on clinician experience and expertise in light of the clinical presentation of the patient, the available evidence, available diagnostic and treatment options, and the patient's values, expectations, and preferences. However, we suggest that significant departures from accepted guidelines be documented in the patient's medical records at the time of the relevant clinical decision.

RATIONALE AND SCOPE

Rationale

Hip fracture is a leading cause of profound morbidity in individuals aged 65 years and older, ranking in the top 10 causes of loss of disability-adjusted life-years for older adults.[37,39,40,56,74,93,94,98,197,239] Worldwide, the number of people with hip fracture is expected to rise significantly due to the aging population and other factors.[39,46,51,146] In 2016, more than 228 000 female and 109 000 male Medicare enrollees were hospitalized with hip fracture (aged 65 years and older).[108] The medical care for individuals with hip fracture continues to be a major health care expenditure in the United States, with 316 000 hospital admissions annually and a cost of $4.9 billion to treat femoral neck fractures alone.[185]

Ninety percent of all hip fractures in people 65 years and older result from a ground-level fall. Fractures from these low-energy traumatic falls are commonly called fragility fractures. Poor functional outcome after hip fragility fracture has been extensively documented.[23,34,53,70,124,141,203] People recovering from hip fracture are at high risk for muscle weakness, fear of falling, and limitations in mobility, self-care, and participation that last for months after surgery.[23,53,56,79,186]

Evidence indicates that those with hip fracture have substantially higher risk of death up to 1 year after fracture. One study found a 15-fold higher risk of death for those with hip fracture during the first month compared with their uninjured peers.[53] In this study, the excess mortality was not fully explained by poor prefracture health status, indicating that some mortality risk is related to the fracture itself.[141] A meta-analysis of articles from 1957 to 2009 found an up to 8-fold higher risk of death within 3 months after hip fracture.[97] One-year mortality after hip fracture was 21.9% for women and 32.5% for men.[34]

In a study comparing Medicare beneficiaries with hip fracture to those without, after accounting for prefracture health, functional status, comorbidities, and socioeconomic status, there was significant excess mortality from fracture 6 months (hazard ratio = 6.28; 95% confidence interval [CI]: 4.82, 8.20), but no excess mortality 12 months (hazard ratio = 1.04; 95% CI: 0.88, 1.23), after fracture.[262] This study reported 35% (176/500) mortality after hip fracture among those reporting good or excellent health, and 43% (99/230) among those reporting fair/poor health or who had missing health data. Mortality for beneficiaries without hip fracture was 18% (3269/17 678) for those reporting good or excellent health, and 46% (3093/6770) for those reporting fair/poor health or who had missing health data. This work indicates that an important contribution to death after hip fracture is underlying frailty in this population. Among older adults with hip fracture, the risk of subsequent fracture at 1 year is 4% to 8%, with increasing probability for increasing age, female sex, and comorbid conditions. Hip fracture is the most likely subsequent fracture type.[41] Fracture care is associated with increased risk of starting opioids and other medications that have important side effects and increase fall risk.[196] Care is provided for individuals recovering from hip fracture across the health care spectrum—inpatient (acute-care hospital, rehabilitation, and skilled nursing facilities) and community (home care, outpatient)—involving providers from a wide range of disciplines, including orthopaedic surgery, anesthesiology, geriatrics, endocrinology, physical therapy, occupational therapy, nursing, nutrition, and social services.[188,263]

Physical therapist management is recommended within medical, surgical, and multidisciplinary CPGs[10,36,199] and is considered to be the standard of care in rehabilitation for people with hip fracture. However, existing CPGs provide little detail to guide physical therapist clinical decision making. Therefore, the goal of this CPG was to review the evidence relevant to physical therapist management and to provide evidence-based recommendations for physical therapy diagnosis, prognosis, intervention, and assessment of outcome in adults with hip fracture. For the purpose of this CPG, we define "older adults" as those who are aged 65 years or older.

Scope

This CPG is focused on low-energy fractures of the proximal femur in older adults, which are most likely related to falls and osteoporosis. Therefore, it does not address fractures due to high-velocity trauma, pathological fractures due to cancer or other disease, or fractures of the acetabulum. This CPG focuses on physical therapist management of existing hip fracture through the entire episode of care, with an emphasis on interventions and outcome measures. This CPG does not address physical therapist management of patients with hip fracture who receive palliative management. This CPG was developed for physical therapists practicing in the United States. However, the literature used as evidence was not limited to the United States, and the members of the guideline development team (GDT) were not exclusively from the United States. The GDT actively sought input from stakeholders outside the United States through presentations at global conferences and inviting peer reviewers from multiple countries. Our goal was to make this CPG applicable to physical therapists practicing globally, with the caveat that differences in health systems, policy environments, and values will influence the applicability of recommendations.

Methods

Content experts were appointed by the Academy of Orthopaedic Physical Therapy and the Academy of Geriatric Physical Therapy of the APTA to conduct a review of the literature and to develop a CPG for physical therapy management of older adults with hip fracture, as indicated by the current state of the evidence in the field. The team consisted of physical therapist clinicians and researchers with expertise in CPG methodology and in the area of hip fracture, with orthopaedic and geriatric perspectives from the United States and Denmark.

EXAMINATION – OUTCOME MEASURES

The GDT incorporated the work of the APTA Evaluation Database to Guide Effectiveness (EDGE) Task Force, which was charged with identifying outcome measures for older adults with hip fracture and whose work was conducted in 2012-2013. The EDGE Task Force performed comprehensive searches on www.Rehabmeasures.org (now www.sralab.org) and StrokEDGE using the terms "hip fracture" and "older adults." A master list of measures was compiled, including 63 outcome tests and measures. The task force solicited additional known relevant tools and added to the final list based on consensus. Six physical therapy experts were consulted to recommend inclusion or exclusion for use in a CPG. More than 4 recommendations were required for inclusion. Instruments were organized by measurement constructs, for example, chair rise (both the 5-times sit-to-stand [5TSS] and 30-second chair-rise tests), gait speed (10 m, 4 m), and endurance (6-minute walk test [6MWT] and 2-minute walk), and were rated using the EDGE procedures and rating form, giving priority to evidence from studies in hip fracture samples. This work resulted in a list of 32 relevant outcome measures for consideration. The GDT expanded this list to include 40 measures. A focused literature review on the measurement properties of each measure was conducted and updated as of May 2019. Teams of 2 independently reviewed the studies of measurement properties of each instrument in samples with hip fracture and conducted critical appraisal of measurement properties using a prespecified tool.[32] The target range of reliability estimates that was considered sufficient was $r>0.7$. For validity hypothesis testing, the target range for sufficient correlation was moderate ($r>0.4$). In addition to rating the quality of the evidence for individual measurement properties, to characterize the evidence across properties, the GDT assigned levels of evidence according to a prespecified method based on consensus (see below). A detailed description of the search strategy, literature review, and critical appraisal process is provided in appendices specified later in this document.

LEVELS OF EVIDENCE

An abbreviated version of the grading system is provided below.

I	At least 2 reliability and 2 validity studies rated adequate quality
II	At least 1 reliability and 1 validity study rated adequate quality
III	At least 1 reliability or 1 validity study rated adequate quality

GRADES OF RECOMMENDATION

GRADES OF RECOMMENDATION		LEVEL OF OBLIGATION
A	Strong	Must or should
B	Moderate	Should
C	Weak	May

INTERVENTION RECOMMENDATIONS

The CPG authors worked with research librarians with expertise in systematic reviews to perform a systematic search for hip fracture articles related to intervention strategies within the scope of physical therapist practice. Briefly, the following databases were searched from 2005 to 2014: MEDLINE (PubMed), CINAHL (EBSCO), the Physiotherapy Evidence Database (PEDro), and the Cochrane Library (Wiley). The intervention search was updated through June 2020. See **APPENDIX A** (available at www.jospt.org) for full search strategies and **APPENDIX B** (available at www.jospt.org) for search dates and results.

The authors declared relationships and developed a conflict management plan, which included submitting a conflict-of-interest form to the Academy of Orthopaedic Physical

Therapy of the APTA. Articles that were authored by a reviewer were assigned to an alternate reviewer. Funding was provided to the GDT for travel and expenses for CPG development training by the Academy of Orthopaedic Physical Therapy and the Academy of Geriatric Physical Therapy, and by a grant from the APTA. The GDT maintained editorial independence.

At the point of full-text review, several systematic reviews and meta-analyses were identified. Therefore, systematic reviews and meta-analyses were selected for intervention evidence where available. Articles contributing to recommendations were reviewed based on prespecified inclusion and exclusion criteria, with the goal of identifying evidence relevant to physical therapist clinical decision making for older adults with hip fracture. See **APPENDIX C** (available at www.jospt.org) for inclusion and exclusion criteria. The title and abstract of each article were reviewed independently by 2 members of the GDT for inclusion. Full-text review was then similarly conducted to obtain the final set of articles for contribution to recommendations. The team leader (C.M.M.) provided the final decision for discrepancies that were not resolved by the review team. See **APPENDIX D** (available at www.jospt.org) for the flow chart of articles. For selected relevant topics that were not appropriate for the development of recommendations, such as incidence and risk factors, articles were gathered, reviewed, and synthesized, but were not subject to a formal systematic review process and were not included in the flow chart. Evidence tables for articles included in the systematic review for this CPG are available on the Clinical Practice Guidelines page of the Academy of Orthopaedic Physical Therapy of the APTA website (www.orthopt.org).

For medical and surgical topics of relevance to physical therapist management, high-quality CPGs were identified and formally reviewed for inclusion using the ADAPTE CPG adaptation framework.[3] Critical appraisal was conducted using the Appraisal of Guidelines for Research & Evaluation II (AGREE II) instrument[4,35] by 2 independent reviewers within the GDT. Consensus was reached by discussion, and a third reviewer provided the final decision for discrepancies not resolved by initial discussion. Relevant recommendations from CPGs deemed to be of high quality, based on the AGREE II review, were eligible for inclusion. The recommendation strength was determined by the GDT in accordance with the original recommendation and its direct relevance to physical therapist management of older adults with hip fracture.

The intervention recommendations are based on the published literature through June 2020. The outcome measure recommendations are based on the literature through May 2019. This guideline will be subject to the Academy of Orthopaedic Physical Therapy's approved evidence surveillance process, which includes regular review of relevant literature and certification of recommendation currency or a call for revision. Any updates to the guideline will be noted on the Academy of Orthopaedic Physical Therapy of the APTA website (www.orthopt.org).

LEVELS OF EVIDENCE

Individual clinical research articles were graded according to criteria adapted from the Centre for Evidence-Based Medicine (Oxford, UK) for diagnostic, prospective, and therapeutic studies.[219] In teams of 2, each reviewer independently assigned a level of evidence and evaluated the quality of each article using a critical appraisal tool. See **APPENDICES E** and **F** (available at www.jospt.org) for the levels of evidence table and details on procedures used for assigning levels of evidence (also available at www.orthopt.org). The evidence update was organized from the highest to the lowest level of evidence. An abbreviated version of the grading system is provided below.

I	Evidence obtained from high-quality diagnostic studies, prospective studies, randomized controlled trials, or systematic reviews
II	Evidence obtained from lesser-quality diagnostic studies, prospective studies, systematic reviews, or randomized controlled trials (eg, weaker diagnostic criteria and reference standards, improper randomization, no blinding, less than 80% follow-up)
III	Case-control studies or retrospective studies
IV	Case series
V	Expert opinion

STRENGTH OF EVIDENCE AND GRADES OF RECOMMENDATION

The strength of the evidence supporting the recommendations was graded according to the previously established methods for the original guideline and those provided below. Each team developed recommendations based on the strength of evidence, including how directly the studies addressed the question of management of older adults with hip fracture. In developing their recommendations, the authors considered the strengths and limitations of the body of evidence and the health benefits, side effects, and risks of tests and interventions.

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	Weak evidence	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies

GRADES OF RECOMMENDATION		STRENGTH OF EVIDENCE
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guideline development group

GUIDELINE REVIEW PROCESS AND VALIDATION

Reviewers who are experts in hip fracture management and rehabilitation reviewed the CPG draft for integrity, accuracy, and to ensure that it fully represents the current evidence for the condition. The guideline draft was also posted for public comment and review on www.orthopt.org, and a notification of this posting was sent to the members of the Academy of Orthopaedic Physical Therapy and the Academy of Geriatric Physical Therapy, APTA, Inc. In addition, a panel of consumer/patient representatives and external stakeholders, such as claims reviewers, medical coding experts, academic educators, clinical educators, physician specialists, and researchers, also reviewed the guideline. All comments, suggestions, and feedback from the expert reviewers, the public, and consumer/patient representatives were provided to the authors and editors for consideration and revisions. Guideline development methods, policies, and implementation processes are reviewed at least yearly by the Academy of Orthopaedic Physical Therapy, APTA's Clinical Practice Guideline Advisory Panel, including consumer/patient representatives, external stakeholders, and experts in physical therapy practice guideline methodology.

DISSEMINATION AND IMPLEMENTATION TOOLS

In addition to publishing these guidelines in the *Journal of Orthopaedic & Sports Physical Therapy* (*JOSPT*), these guidelines will be posted on CPG areas of the JOSPT, Academy of Orthopaedic Physical Therapy, Academy of Geriatric Physical Therapy, and APTA websites, which are free-access website areas, and submitted to be made freely available on the ECRI Guidelines Trust (https://guidelines.ecri.org) and the PEDro (https://pedro.org.au/). A link to the CPG will be included in the Fragility Fracture Network Clinical Toolkit (www.fragilityfracturenetwork.org). The implementation tools planned to be available for patients, clinicians, educators, payers, policy makers, and researchers, and the associated implementation strategies, are listed in **TABLE 1**.

ORGANIZATION OF THE GUIDELINE

Although all patients targeted by this guideline will begin in the inpatient hospital setting, the postacute settings vary, and may include inpatient rehabilitation, skilled nursing, home care, and outpatient settings. Other than the acute/inpatient period, the settings overlap across time periods. The evidence and recommendations are organized into 3 main categories: (1) across the entire episode of care; (2) the early postoperative period, which includes the inpatient acute-care hospital, postacute inpatient rehabilitation, and skilled-nursing settings; and (3) later rehabilitation, which occurs in community-based settings, including home care and outpatient care.

For some topics, where a systematic review was determined to be outside the scope of this CPG, a summary of the literature is provided, for example, risk factors, pathoanatomic features, clinical course, and diagnosis. For intervention topics in which systematic reviews were conducted to support specific recommendations, summaries of studies with the corresponding evidence levels are followed by a synthesis of the literature and rationale for the recommen-

TABLE 1 Planned Strategies and Tools to Support the Dissemination and Implementation of This Clinical Practice Guideline

Tool	Strategy
JOSPT's "Perspectives for Patients" and/or "Perspectives for Practice" articles	Patient-oriented and clinician-oriented guideline summaries available at www.jospt.org
Mobile app of guideline-based exercises for patient/clients and health care practitioners	Marketing and distribution of app using www.orthopt.org
Clinician's Quick-Reference Guide	Summary or guideline recommendations available at www.orthopt.org
JOSPT's Read for Credit℠ continuing education units	Continuing Education Units available for physical therapists and athletic trainers at www.jospt.org
Webinars: educational offering for health care practitioners	Guideline-based instruction available for practitioners at www.orthopt.org
Mobile and web-based app of guideline for training of health care practitioners	Marketing and distribution of app using www.orthopt.org
Physical Therapy National Outcomes Data Registry	Support the ongoing usage of data registry for common musculoskeletal conditions (www.ptoutcomes.com)
Logical Observation Identifiers Names and Codes mapping	Publication of minimal data sets and their corresponding Logical Observation Identifiers Names and Codes for the hip region at www.orthopt.org
Non-English versions of the guidelines and guideline implementation tools	Development and distribution of translated guidelines and tools to JOSPT's international partners and global audience

dation, discussion of gaps in the literature if appropriate, and the recommendation(s). For "Examination – Outcome Measures," we provide a summary table of recommended measures. A detailed summary of evidence for each measure is provided in online appendices, as listed later in this document.

CLINICAL PRACTICE GUIDELINES

Impairment/Function-Based Diagnosis

PREVALENCE/INCIDENCE

Globally, hip fracture incidence rates vary by 10-fold.[46,135] The highest rates have been reported in Northern Europe, and the lowest were found in Africa and Latin America. The United States was found to have moderate risk compared to age-adjusted global rates.[135] Rates in the United States were 8.1 and 6.2 per 1000 for women and men, respectively, in 2012.[44] The incidence of hip fracture also varies in the same geographic area over time. By 2030, women in the United States are projected to have a 3.5% decreased incidence, while men will experience a 51.8% increased incidence.[250] This represents a projected rise of 11.9%, from 258 000 cases in 2010 to 289 000 cases in 2030 for those 65 years of age and older.

A reported decreased incidence in hip fracture in women 65 years of age and older in the United States between 1995 and 2005, similar to a decrease in incidence rates in Europe, is not fully understood but may relate to initiation of systematic medical osteoporosis treatment. The incidence of Medicare hip fractures in the United States showed a steady decline, from 830 per 100 000 in 1996 to 620 per 100 000 by 2012.[44] Despite a general decline, some populations have shown increased incidence of hip fracture, with a higher incidence in African-American/Asian women in the United States.[73,278] The incidence increases exponentially with age.[233] In the United States, prevalence was about 75% in women and 25% in men in 2010 (n = 186 000 and 72 000, respectively).[238]

PATHOANATOMIC FEATURES

Hip fractures are fractures of the proximal femur (**FIGURE 1**). They are classified by location: (1) intracapsular, including the femoral neck, and (2) extracapsular, including the trochanteric area (intertrochanteric fractures) and just distal to it (subtrochanteric fractures).[213] Surgical treatment is highly location specific, with specialized implant devices for many different fracture patterns. Fractures of the femoral head are typically the result of high-energy fracture dislocations and are not included in this CPG.[9] About half of all hip fractures in the United States are intertrochanteric, 37% are femoral neck, and 14% are subtrochanteric.[39] Intertrochanteric fractures are associated with poorer health status compared with femoral neck fractures,[86] and their relative incidence increases with age.[137] Hip fractures may be nondisplaced, displaced, stable, unstable, or mixed patterns. Older adults were more likely to have trochanteric than femoral neck fractures,[80] and more likely to have more severe fracture types, such as displaced femoral neck and unstable intertrochanteric fractures. Low bone mineral density (BMD) and hip geometries are associated with nondisplaced femoral neck and stable intertrochanteric fractures.[42] It is hypothesized that for those with low BMD, less force may be required for fracture to occur, perhaps resulting in less displacement.[42]

RISK FACTORS FOR HIP FRACTURE

Individual risk factors for hip fracture in individuals 65 years of age and older have been extensively explored. In addition to reduced BMD,[62] a range of other factors have been identified,[39] including older age,[233] female sex,[34] low body mass index (BMI),[62] ethnicity,[54] being postmenopausal without

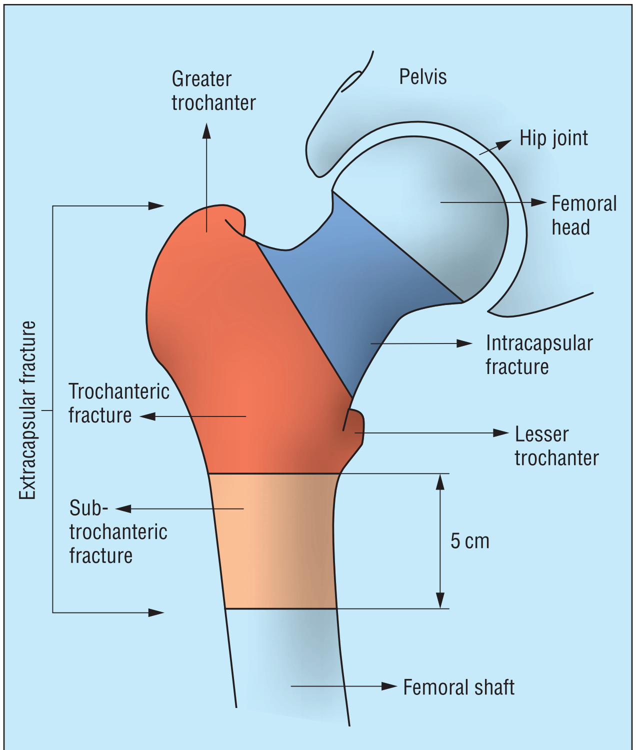

FIGURE 1. Classification of hip fractures. Fractures in the blue area are intracapsular and those in the red and orange areas are extracapsular. Reproduced with permission from Parker M, Johansen A. Hip fracture. *BMJ*. 2006;333:27-30. https://doi.org/10.1136/bmj.333.7557.27. Copyright ©2006 BMJ Publishing Group Ltd.

estrogen replacement therapy,[229] femoral geometry,[76] previous hip fracture,[205] smoking,[62] vitamin D deficiency,[173] low dietary calcium intake,[113] and hypervitaminosis A,[78] among many others.

There are multiple risk factor assessment tools that may assist in identifying those who are at risk for future hip fracture.[6,19,28,112,200,222,234] The 2 main risk factor assessment tools are The Canadian Association of Radiologists and Osteoporosis Canada tool[179] and the widely used WHO fracture risk algorithm (FRAX), which includes clinical risk factors and geographic and ethnic factors and allows prediction with and without BMD.[104] The clinical risk factors included in the FRAX are age (range, 40-90 years), female sex, low BMI, previous adult low-trauma fracture, parental history of hip fracture, current smoking, history of taking oral glucocorticoids (5 or more mg/d) or prednisone for 3 or more months, confirmed diagnosis of rheumatoid arthritis, secondary osteoporosis, alcohol intake (3 or more drinks per day), and low femoral neck BMD.

Falls

More than 90% of hip fractures are the result of falls, and fall risk factors are independent predictors of hip fracture, regardless of low BMD.[43] The factors that independently elevate fall risk include older age, prior fracture after age 50, Parkinson's disease, type 2 diabetes, impaired depth perception, and slower walking speed.[255] The mechanics of falling have been found to be important to risk of hip fracture. It has been estimated that a fall from standing height can produce 10 times the force required to fracture the hip of an older woman.[60] Yet, only 1% of falls in older women resulted in hip fracture. The orientation and location of impact, height, and falling body weight determine the type of fracture, and protective responses and impact surfaces determined whether a fracture occurred.[60] A sideways fall is the most likely fall type.[105] Using engineering principles, fall severity has been estimated by type of fall, the load required to cause a hip fracture, and fall mechanism, including descent and impact.[106] Among long-term care residents who fell, falling sideways, lower BMD, taller height, lower BMI, and impaired mobility were predictors of hip fracture.[92]

Biomechanical modeling has been used to investigate movement strategies during falling. Results indicated that lower extremity flexion combined with axial rotation lowered impact force and that using the arm to break the fall decreased the risk of fracture.[5] Fear of falling is associated with fall risk in older people.[177,235] A syndrome of geriatric falls and fractures as a consequence of instability and immobility, characterized by a cycle of weakness, immobility, neuromuscular impairment, instability, falls, and fractures, has been described.[69] Support for this model comes from studies that have shown that exercise programs addressing fall prevention reduce both the rate of falls and the severity of injuries sustained in falls.[72,267] In addition, people aged 60 years or older were found to have increased odds of multiple falls if 4 or more of the following risk factors were present: difficulty standing from a chair, difficulty with tandem walking, arthritis, Parkinson's disease, 3 or more falls in the prior year, a prior fall with injury, or Caucasian race.[202]

CLINICAL COURSE

In this section, we address 2 main issues relevant to the clinical course of patients recovering from hip fracture after surgery: precautions and risk factors for adverse outcomes according to fracture type and surgical treatment, based on the American Academy of Orthopaedic Surgeons (AAOS) 2014 CPG.[10,36]

After hip fracture surgery, restrictions are rarely placed on weight-bearing status. The evidence to support weight bearing as tolerated comes from observational studies, often retrospective studies over decades, to determine whether unrestricted weight bearing was associated with complications such as surgical revision. Although largely from observational studies, the evidence supports weight bearing as tolerated as early as possible after surgery, based on lack of adverse events or complications and improvements in balance and mobility outcomes.[11,18,48,101-103,144,147,148,188,195]

TABLE 2 summarizes fracture types and their related surgical interventions and related postsurgical precautions.

An international task force investigating hospitalization and functional decline in older adults highlighted 3 main elements of "iatrogenic disability": (1) pre-existing frailty, (2) severity of admitting diagnosis, and (3) hospital process of care/structure.[169] The chief risk factors for functional and mortality outcomes in the short and long term are summarized in **TABLE 3**. Additional risk factors are provided in **APPENDIX G** (available at www.jospt.org).

Surgery-Related Factors Associated With Outcomes Following Hip Fracture

Surgery-related risk factors for adverse outcomes have been well summarized in CPGs (see **APPENDIX H** for detailed summary, available at www.jospt.org).[36,230,238] In general, surgical treatment allows early functional mobility after hip fracture. Nonsurgical treatment of hip fractures is associated with increased complications and poor fracture healing. Strong evidence supports arthroplasty for displaced femoral neck fractures.[36,230] Mortality rates at 6 months and 1 year show no significant differences between unipolar and bipolar hemiarthroplasty, although unipolar implants have been associated with acetabular erosion and some reports of increased pain.[17,109,120] A total hip arthroplasty is recommended over hemiarthroplasty for active, younger people, due to hemiarthroplasty's association with pain for more active individuals. Unstable intertrochanteric and subtrochanteric fractures treated with a cephalomedullary device have demonstrated improved mobility and decreased limb shortening compared to outcomes for the sliding hip screw.[230] The sliding hip screw, also called a dynamic or compression hip screw, allows postoperative impaction of the femoral neck fracture, to assist with bone healing.

DIAGNOSIS

This section refers to physical therapist diagnosis to guide clinical decision making. For the majority of patients with hip fracture, physical therapist management begins after hip fracture diagnosis and most often after surgery, in the inpatient hospital setting. The large majority of patients will undergo surgery for fracture fixation or hip replacement, but a small proportion will receive palliative management. Therefore, this CPG is focused on management of existing hip fracture, beginning in the inpatient setting. Due to the high prevalence of osteoporosis in older people, we acknowledge the possibility of an occult hip fracture in the absence of a fall. However, this guideline does not address identification of occult hip fractures in physical therapist practice.

CLASSIFICATION

The primary International Classification of Diseases, 10th revision (ICD-10) codes related to hip fracture are provided below, excluding Pathological, Physeal/Growth Plate, Mechanical complication of other bone devices, Implants and grafts, Dislocation, Congenital, and Late effects: **S72.0 Fracture of head and neck of femur**, **S72.1 Per/intertrochanteric fracture**, **S72.2 Subtrochanteric**. Other related codes associated with hip fracture are **M25.65 Stiffness in hip**, **M25.55 Pain in hip**.

The primary ICF body function codes associated with the above-noted primary ICD-10 conditions are the sensory functions related to pain and the movement-related functions related to joint mobility. These body function codes are **b265 Touch function**, **b2801 Pain in body part**, **b28015 Pain in lower limb**, **b7100 Mobility of a single joint**, **b7150**, **Stability of a single joint**, **b7300 Power of isolated muscles and muscle groups**, **b7401 Endurance of muscle groups**, **b770 Gait pattern functions**, **b7800 Sensation of muscle stiffness**, and **b7801 Sensation of muscle spasm**.

The primary ICF body structure codes associated with hip pain and mobility deficits are **s7400 Bones of the pelvic region**, **s75001 Hip joint**, **s7402 Muscles of the pelvic region**, and **s7403 Ligaments and fascia of the pelvic region**.

The ICF activities and participation codes associated with mobility deficits are provided at a high level, because most or all tasks and activities within each higher-level code are affected: **d410 Changing basic body position**, **d415 Maintaining a body position**, **d420 Transferring oneself**, **d430 Lifting and carrying objects**, **d450 Walking**, **d455 Moving around**, **d460 Moving around in different locations**, **d465 Moving around using equipment**, **d470 Using transportation**, and **d475 Driving**.

Similarly, the ICF activities and participation codes associated with self-care are provided at the highest level: **d510 Washing oneself**, **d520 Caring for body parts**, **d530 Toileting**, **d540 Dressing**, **d550 Eating**, **d560 Drinking**, and **d570 Looking after one's health**.

CLINICAL PRACTICE GUIDELINES

Examination

OUTCOME MEASURES

The literature review addressed instruments to measure outcomes of physical therapy intervention. In this section, we provide a brief summary of the recommended measures, followed by a summary table of recommendations for older adults with hip fracture, organized by ICF level of functioning (**TABLE 4**). As described in the Methods section, evidence summaries refer to the strength of evidence supporting sufficient reliability (r or intraclass correlation coefficient [ICC] greater than 0.7) and validity (correlations greater than 0.4). A detailed summary of the measurement properties of each measure is provided in **APPENDIX I** (available at www.jospt.org).

The main domains for measurement of patients with hip fracture are impairment (pain, knee extensor strength) and activity limitations (functional mobility, fall risk, and gait speed).

BODY FUNCTIONS AND STRUCTURES – PHYSICAL IMPAIRMENT MEASURES

Lower Extremity Muscle Strength/Power

Knee extension strength of the fractured side approximately 2 weeks after fracture is on average reduced by more than 50% compared to the nonfractured side.[154,193,242] Knee extension, hip extension, and hip abduction can be assessed using different strength-testing devices, for example, a dynamometer, a "spring balance," the Nottingham power rig, an isokinetic muscle strength testing device, and free weights or resistance training machines for repetition-maximum (RM) testing (eg, weight load lifted during a 10-RM test). A handheld dynamometer is commonly used for patients with hip fracture.[166,241] A belt- or strap-fixated approach is recommended to conduct a "make test," where the patient holds maximal isometric contractions for 3 to 5 seconds. For the frailest/weakest individuals, manual muscle testing may be used.[30] Evidence for reliability[142,241] and validity[154,171,210] in older adults with hip fracture was strong (ICC = 0.95 for strength measurements for the fractured limb). The GDT calculated the standard error of measurement (SEM) for the fractured limb as 1.0 kg and the minimum detectable change at the 90% confidence level (MDC_{90}) as 2.3 kg. For the nonfractured limb, the ICC was 0.95, the SEM was 1.6 kg, and the MDC_{90} was 3.7 kg.[142]

Evidence Summary and Rationale

There was strong (level I) evidence for reliability of knee extensor strength measurements and moderate evidence for hip extensor and abductor strength measurements. Clinical circumstances will affect the feasibility of the methods used. The importance of lower extremity strength to functional outcome provided additional support for this recommendation.

Recommendations

A Physical therapists must test and document knee extension strength across all settings.

B Physical therapists should test and document hip extensor and abductor muscle strength in postacute clinical settings.

Verbal Rating (Ranking) Scale for Pain

The verbal rating (ranking) scale (VRS) is a self-report measure that can be used for pain at rest and during activity. The VRS for pain has been used to measure hip fracture–related pain in acute, postacute, and outpatient settings. There is evidence to support test-retest reliability (Pearson's r = 0.75-0.93) and validity, and the 0-to-4-point VRS has proven superior to the visual analog scale (VAS) in patients with hip fracture.[178] There is some evidence to support use in patients with cognitive impairment.[20] Estimates of minimal clinically important difference (MCID) and MDC for hip fracture have not been reported. Evidence for reliability[20,178] and validity[111,152] in older adults with hip fracture was strong.

Evidence Summary and Rationale

Strong (level I) evidence was found for reliability and validity of the VRS for pain in older adults with hip fracture, and it was found to be clinically feasible.

Recommendation

A Physical therapists must administer and document the VRS for pain in all settings to monitor pain.

ACTIVITY LIMITATIONS – PHYSICAL PERFORMANCE MEASURES

5-Times Sit-to-Stand Test

The 5TSS (also called "chair rise") test is a mobility measure that assesses the ability to perform transfers at the activity level. This performance-based measure is conducted using a straight-backed chair (against a wall)[31,194] by recording the time it takes to stand up and sit down 5 times with the arms folded across the chest.[59,194] The test is limited to higher-functioning patients because upper extremity use is not permitted. Five sit-to-stand transitions are required to register a score.[96,181] An alternative test, the 30-second chair rise, was developed within the Senior Fitness Test battery and counts the number of transitions one can perform in 30 seconds. Although measurement properties have been well established in community-dwelling older adults,[227,228] there were fewer measurement studies in patients after hip fracture.

Evidence Summary and Rationale

Level II (moderate) evidence for reliability and validity was found for the 5TSS.[67,75] Although the evidence was specific to the 5TSS, the GDT acknowledges the potential feasibility of the 30-second version of the test for patients who are unable to complete 5 repetitions. The 5TSS test is also recommended as a test to assess risk for falls in older adults. Because 90% of hip fractures are associated with a fall, fall-risk assessment and management are critical in this population. Refer to the fall-risk management guideline for specific recommendations.[15]

Recommendation

B Physical therapists should conduct and document the 5TSS or 30-second sit-to-stand test in postacute inpatient, home, and outpatient settings to measure mobility and fall risk.

6-Minute Walk Test

The 6MWT is a performance-based measure of walking endurance in older adults with hip fracture in postacute and outpatient rehabilitation settings at the activity level.[64,171,210,211] Distance in meters is measured while an individual walks, using assistive devices if needed, as far as possible without running for 6 minutes on at least a 12-m walkway. Two cones are placed at each end of the walkway, and patients circle the distance for the test duration.[38] Hip fracture–related pain was associated with performance on the 6MWT, and therefore pain during testing should be documented.[210,211] There was strong evidence for reliability[211] and validity[64,171,210,251] for the 6MWT in older adults with hip fracture. Estimates were as follows: MDC_{95}, 59.4 m[211]; MDC_{90} with rollator, 49.8 m[211]; and MCID, 35.4 m.[64]

Evidence Summary and Rationale

There is level II evidence for the measurement properties of the 6MWT for older adults with hip fracture, and it is a recommended measure within the Academy of Neurologic Physical Therapy's Core Outcome Measures.

Recommendations

B Physical therapists should use the 6MWT in postacute inpatient and community settings when the patient does not require the therapist's physical assistance to walk and when there is an adequate length of corridor to conduct the test.

Gait Speed

Gait speed is a performance-based measure of walking distance and time. It has been measured over various walking course lengths and is included as part of the Short Physical Performance Battery (SPPB). Gait speed has been studied in patients post fracture and can be used in all settings and at all phases of recovery; however, factors such as instructions, pace, distance walked, assistance, and assistive-device use all impact the outcome. Gait speed should be recorded only for those individuals who do not need human assistance to walk. The MDC_{95} values for habitual and fast speeds were 0.08 and 0.10 m/s, respectively.[212] The MDC_{95} range in patients 2 to 120 months post fracture (mean, 9 months) was 0.08 to 0.17 m/s.[212] The MCID for normal gait speed is 0.10 m/s.[212] There is strong evidence for reliability[212,241] and validity[8,64,89,154,171,212,237] of gait speed for older adults with hip fracture.

Evidence Summary and Rationale

There is level I evidence for gait speed as an outcome measure. However, improvement in gait speed may be limited by factors other than hip fracture rehabilitation, such as cardiorespiratory status. The evidence supports the obligation level of "must." However, recognizing that local and environmental constraints may impact feasibility, the GDT used "should."

Recommendation

A Physical therapists should use the gait speed test in all settings when patients do not require human assistance to walk. Documentation should include the features of test administration: comfortable or maximum speed, walking aid, and rolling start or static start.

Short Physical Performance Battery

The SPPB measures balance, mobility, strength, and endurance. Activities include standing with feet together side by side and in the semi-tandem and tandem positions, time to walk 2.44 m (8 ft), and time to rise from a chair and return to a seated position 5 times.[96] There is evidence of validity in older adults with hip fracture.[171] Reliability and MDC estimates were based on community-dwelling older adults.[171]

Evidence Summary and Rationale

There is level III evidence for the SPPB. It has been used in many large epidemiological studies of frail older adults. It includes important dimensions of functioning; however, the evidence on measurement properties specific to older adults with hip fracture is limited. This has impacted the level of evidence and strength of recommendation for this measure.

Recommendation

C Physical therapists may use the SPPB in all settings, though completion may not be feasible in the early postoperative period, depending on ability.

Timed Up-and-Go Test

The timed up-and-go (TUG) test records the time it takes a person to stand up from a standard chair with arm rests (seat height of about 45 cm), walk 3 m to a line drawn on the floor, turn around, walk back to the chair, and sit down again. Between 1 timed trial[221] and the average of 3 trials are used. Improvement on up to 3 timed trials has been reported.[29,157] Also, the use of different walking aids when comparing performances between individuals and for measuring changes over time has been questioned.[156,159,237] Thus, patients with hip fracture who performed the TUG test with a walker used, on average, 13.6 (95% CI: 11.2, 16.1) seconds more time to complete it than when using a 4-wheeled rollator.[156] Patients with hip fracture able to walk without an aid when admitted to a subacute rehabilitation setting showed greater improvements at follow-up when performing the test without a rollator.[237] Different instructions, such as the phrase "comfortable pace" or "as quickly and safe as possible," are commonly used and might influence performance. Thus, physical therapists should follow the same instructions/manual and be aware of the walking-aid influence when testing, retesting, and interpreting results. The following have been reported: MDC_{95} of 6.8 seconds (MDC_{95} of 31%), MDC_{90} of 5.7 seconds,[161] MCID (anchor based) of 2.5 seconds, and MCID (distribution based) of 4.6 seconds.[67]

There is strong evidence for reliability[67,161] and validity[67,87,88,122,123,152,154,156,159,160,168,190,204,237] of the TUG test for older adults with hip fracture.

Evidence Summary and Rationale

There is level I evidence for the TUG test in older adults with hip fracture. It is also a recommended measure for fall-risk assessment and prevention.[15,184] Therefore, it is strongly recommended by the GDT for use in patients with hip fracture to address mobility and fall risk. The evidence supports the obligation level of "must." However, recognizing that local and environmental constraints may impact feasibility, the GDT used "should."

Recommendation

A Physical therapists should use the TUG test in all settings to measure mobility and risk for falls when patients do not require human assistance. Documentation should include the features of test administration: comfortable or maximum speed and walking-aid use.

Cumulated Ambulation Score

The Cumulated Ambulation Score (CAS) is a performance-based measure that evaluates the basic mobility status of the patient's independence in 3 basic activities (getting in and out of bed, sit-to-stand-to-sit from a chair, and walking).[77,85,153] It can also be administered by patient or proxy report. Prefracture and acute hospital discharge CAS scores are required in the nationwide Danish Multidisciplinary Hip Fracture Registry.[164] The CAS was recently included in the Irish Hip Fracture Database. The CAS can be used for all patients, independent of their functional and cognitive levels. Each of the 3 CAS activities is rated on a 3-point ordinal scale, where 0 is "not able to, despite human assistance and verbal cueing," 1 is "able to, with human assistance and/or verbal cueing from 1 or more persons," and 2 is "able to safely do, without human assistance or verbal cueing." This results in a 1-day CAS score of 0 to 6 points.[153] Also, a 3-day cumulative CAS score of 0 to 18 points (postoperative days 1-3) has been used.[85,153,220] The MDC_{95} and MCID values from postoperative day 1 to discharge in the acute-care setting are 0.55 points[153] and 0.80 points, respectively.[117] The manual and scoring sheet are available on request from a coauthor of this CPG (M.T.K.).

Evidence Summary and Rationale

There is strong evidence, based on level I studies, for reliability[13,91,153] and validity[81,85,91,117,154,158,162,164,217,220] of the CAS for patients with hip fracture working toward independence. It will necessarily be limited in value as an outcome measure once independence in getting out of bed, sit-to-stand, and walking has been achieved. The evidence supports the obligation level of "must." However, recognizing that local and environmental constraints may impact feasibility, the GDT used "should."

Recommendation

A Physical therapists should use the CAS in the acute and postacute clinical settings to measure basic mobility until independent ambulation has been reached.

de Morton Mobility Index

The de Morton Mobility Index (DEMMI), administered by therapist observation of physical performance, consists of 15 hierarchical mobility items (3 bed, 3 chair, 4 static balance, 2 walking, and 3 dynamic balance items), each measured on a 2- (able/unable) or 3 (able/partial/unable)-point scale.[63] The total score is converted from a scale of 0 to 19 to an interval score range from 0 to 100, where 0 represents poor mobility and 100 indicates a high level of independent mobility. There was no evidence for reliability and only moderate evidence for validity[64,117] of this tool in older adults with hip fracture. The MCID is 6 to 8 points.[64,117]

Evidence Summary and Rationale

Although the content covered in the DEMMI is relevant for rehabilitation after hip fracture, there was no direct evidence for reliability of the DEMMI specific to older adults with hip fracture. This limited the level-of-evidence rating and strength of recommendation.

Recommendation

C Physical therapists may use the DEMMI in postacute inpatient and outpatient settings.

Functional Independence Measure

The Functional Independence Measure (FIM) provides motor and cognitive and activities of daily living (ADL) scores. The 13 motor tasks include eating, grooming, bathing, upper- and lower-body dressing, toileting, bladder and bowel management, bed to chair, toilet, and shower transfers, locomotion (ambulation or wheelchair), and stairs. The FIM is used in inpatient rehabilitation settings and is scored at admission and discharge by several members of the rehabilitation team. The FIM has been used as a recall questionnaire in some studies. Tasks are rated on a 7-point ordinal scale from total assistance to complete independence, with total FIM scores ranging from 18 (lowest) to 126 (highest function); the motor FIM scores range between 13 and 91.

Evidence Summary and Rationale

As of October 2019, the FIM is not included on the Centers for Medicare and Medicaid Services mandated tools list. The requirement for training and licensing, and the move toward different mandated measures, has been reflected in the lower strength of recommendation: weak, based on level I evidence.[107,130,131,190,264,276]

Recommendation

C Physical therapists may use the FIM in postacute inpatient settings if they have been trained and have a license to use this measure.

ACTIVITY LIMITATIONS – SELF-REPORT MEASURES

New Mobility Score

The New Mobility Score (NMS; also named the Parker mobility score in the literature) was originally developed as a questionnaire for all patients with hip fracture (including those with cognitive impairment) to describe the patient's prefracture ability to perform 3 activities: (1) indoor walking, (2) outdoor walking, and (3) walking during shopping.[163,214] The NMS is also used to assess the functional level at different time points following fracture.[134,210] The prefracture functional level and older age are the strongest predictors of the outcome of patients with hip fracture. Many patients do not regain their prefracture function following fracture, although this is considered an important minimum goal for all patients with hip fracture. Assessing the prefracture functional level is, therefore, extremely important for identification of high-risk patients who need special attention during rehabilitation. Each of the 3 activities is scored from 0 to 3, where 0 is "not able to," 1 is "able to with help from another person," 2 is "able to with a walking aid," and 3 is "able to with no difficulty and no aid," resulting in a total score ranging from 0 (no walking ability at all) to 9 (fully independent),[163,214] with a SEM of 0.42 and an MDC_{90} of 0.98 points.[155] The manual is available on request from a coauthor of this CPG (M.T.K.).

Evidence Summary and Rationale

There was moderate evidence, based on level II studies, for reliability[155] and validity[81,118,125,155,158,159,214,215,217] of the NMS for older adults with hip fracture in postacute and community settings. The NMS can be used to measure prefracture and functional recovery status.

Recommendation

B Physical therapists should use the NMS in the early period/inpatient setting to assess prefracture status and in postacute and community settings to assess current status and recovery of prefracture status.

Falls Efficacy Scale-International

The Falls Efficacy Scale-International (FES-I) asks the person to rate his or her concerns about falling while performing 16 activities, such as getting dressed and walking on uneven surfaces. The FES-I was developed to expand on the 10-item, 100-point Falls Efficacy Scale,[260] which did not include more challenging activities or social situations; the 10-item version was also translated to Swedish and expanded to 13 items.[121] There is also a shortened version of the FES-I (short FES-I, 7-28 points) that includes 7 of the 16 activities and retains activities that are basic and demanding.[143] The FES-I is scored with a 4-point Likert scale (not at all concerned, somewhat concerned, fairly concerned, very concerned), resulting in a score range from 16 to 64 points, with higher values representing more concerns in fall-prone situations. There is level II evidence for the reliability (ICC = 0.72; SEM, 6.4; MDC_{95}, 17.7)[269] and validity[125,269] of the FES-I in older adults with hip fracture.

Evidence Summary and Rationale

Although there is level II evidence for the FES-I, because the large majority of hip fractures are associated with falls, it is important that clinicians working with patients with hip fracture measure and address their falls self-efficacy.

Recommendation

B Physical therapists in all settings should use the FES-I to measure concern about falling.

Activity Measure for Post-Acute Care

The Activity Measure for Post-Acute Care (AM-PAC) measures the extent of difficulty or assistance needed in performing specific functional tasks for 3 separate instruments or scales: basic mobility; daily activities, addressing personal care and instrumental activities; and applied cognition, addressing cognitive functional activities. The AM-PAC was developed using item response theory methods, which support computer adaptive testing, or short, fixed forms based on a subset of items from the full item bank for each scale. There are several short forms in use, including the "6 Clicks" forms for inpatient provider proxy report.[65,126-128] The final item banks for the scales are 131 and 88 items for the basic mobility and daily activities scales, respectively. Scores on the AM-PAC are reported as T scores, with a mean ± SD of 50 ± 10. Lower scores represent lower mobility and higher scores represent higher mobility.

Evidence Summary and Rationale

The AM-PAC demonstrated strong reliability and validity in large cohorts of patients in postacute care, which included but did not differentiate those with hip fracture. Evidence specific to older adults is somewhat limited, and the proprietary nature of the instrument has affected the GDT's recommendation. However, the conceptual framework and computer adaptive capability make it particularly attractive for detection of changes in status across the episode of care. Therefore, the recommendation is weak, based on level II evidence[67,171] specific to older adults with hip fracture.

Recommendation

C Physical therapists may use the AM-PAC in all settings.

Medical Outcomes Study 36-Item Short-Form Health Survey

The Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) is a widely used instrument that has been translated into more than 170 languages. It measures health status in 8 dimensions and provides 2 summary measures: the physical component summary (PCS) and mental component summary (MCS). The PCS includes information from the physical functioning, role-physical, bodily pain, and general health subscales. Ten items addressing physical function are scored as the 10-item physical functioning scale (PF-10). The PF-10 focuses on limitations in activities because of health problems. The SF-36 requires the use of a proprietary scoring algorithm. There are 8 domain scores, ranging from 0 to 100, where higher scores indicate better health. Two norm-based summary scores are calculated, physical (PCS) and mental (MCS), with a mean ± SD of 50 ± 10, where the mean for the general population is 50. The sum of answers to the 10 physical function questions is used to calculate a score from 0 to 100, where higher scores indicate better physical functioning.

Evidence Summary and Rationale

Although the SF-36 is one of the most widely multidimensional health-status instruments, the evidence to support its use in older adults with hip fracture is best described as level III.[68,100,107,123,171,223,243] This has impacted the strength of the evidence and the strength of recommendation (weak) for the SF-36, including the PCS and PF-10.

Recommendations

C Physical therapists may use the SF-36 PF-10 to measure physical functioning in all settings.

C Physical therapists may use the SF-36 in all settings to measure health-related quality of life (HRQoL).

3-Level Version of the EuroQol-5 Dimensions Scale

There are 2 ways the EuroQol-5 dimensions scale (EQ-5D) can provide an overall score for quality of life, using a VAS or applying an algorithm to the responses (the 3-level version of the EuroQol-5 dimensions scale [EQ-5D-3L]). The EQ-5D-3L covers 5 domains of functioning, often described as HRQoL: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression. Respondents are asked to endorse the statement that best describes their current health in each domain on 3 levels. Raw scores can be converted into an index that results in a score anchored at 0 (equivalent to dead) and 1 (perfect health). Negative values are interpreted as worse than dead. This provides the "profile" or health status classification. There are a range of algorithms based on studies to estimate values from different populations. The MCID is 0.05, using perceived health as the anchor.[115] The EQ-5D can be found at https://euroqol.org/eq-5d-instruments/.

Evidence Summary and Rationale

Although the EQ-5D-3L is widely used to measure HRQoL, evidence specific to older adults with hip fracture remains limited, particularly for reliability.[107,115,192,216,224,259] Therefore, the recommendation is weak, based on level III evidence.

Recommendation

C Physical therapists may use the EQ-5D-3L in all settings to measure HRQoL.

BEST-PRACTICE POINT
Essential Data Elements

Clinicians should use the following measures, at least at baseline and at 1 follow-up time point, for all older adult patients with hip fracture to support standardization for quality improvement in clinical care and research.

Process

- Time from surgery to first transfer out of bed
- Time from surgery to first ambulation

Body Functions and Structures – Physical Impairment Measures
- Knee extensor strength
- Pain VRS

Activity Limitations – Self-report/Proxy-Report Measures
- NMS to document prefracture and recovery status

Activity Limitations – Physical Performance Measures
- CAS
- TUG test
- Gait speed

CLINICAL PRACTICE GUIDELINES

Interprofessional Management

ACROSS THE ENTIRE EPISODE OF CARE

In this section and in the recommendations, the GDT uses the contemporary term *interprofessional*, which refers to when individuals "from two or more professions learn about, from and with each other to enable effective collaboration and improve health."[272] However, in describing individual studies, authors of this guideline use the terms that were used by the study authors.

Physical therapists contribute to the interprofessional management of older adults with hip fracture, including screening for, identifying, and participating in the management of common co-occurring conditions. The GDT has characterized these activities as interprofessional management, and notes that they include screening for medical conditions; adverse events, including postoperative delirium, pain, skin breakdown/ulcers, falls, and dislocation for patients with hip replacement; and co-occurring risks within the scope of physical therapy practice, such as fall risk.

The GDT selected highly prevalent conditions and critical aspects of management based on standards of care and the literature. The GDT uses the term *clinicians* in the recommendations in this section to denote that a physical therapist or a provider from another discipline (eg, nurse, physician, occupational therapist) may perform the recommended action. The use of *physical therapist* is to denote that the physical therapist, specifically, should/must perform the action independent of (most likely in addition to) the actions of team members from other disciplines.

As described in the Methods section of this document, the GDT bases the level of evidence and strength of recommendation on relevant recommendations from high-quality CPGs in these areas. Where recommendations are based solely on best practice or the opinion of the GDT, this is specified in the text and by the "F" strength of recommendation designation.

Prevention and Identification of Delirium

The following recommendation is based on a high-quality CPG from the National Institute for Health and Care Excellence.[198] The CPG reported that moderate evidence was found to support multicomponent nonpharmacological intervention programs delivered by an interprofessional team trained in management of delirium, including assessment of people at risk for recent changes or fluctuations in behavior and referral to a trained provider competent in diagnosing delirium. The CPG indicated that strategies for preventing delirium can include adequate pain management and facilitating movement through therapy and encouraging activities.

These behavior changes may present as cognitive changes (worsened concentration, slow responses, confusion), perceptual changes (visual or auditory hallucinations), reduced mobility, restlessness, agitation, changes in appetite, sleep disturbance, or changes in social behavior (lack of cooperation with reasonable requests, withdrawal, or changes in communication, mood, and/or attitude).[198]

A Physical therapists should participate in multicomponent nonpharmacological intervention programs delivered by an interprofessional team (including physicians, nurses, and possibly other health care professionals) for the entire hospitalization for at-risk older adults undergoing surgery to prevent delirium.

Pain Assessment and Management

The following recommendation is based on a consensus recommendation from a high-quality CPG from the National Institute for Health and Care Excellence.[199]

F Physical therapists must assess hip fracture–related pain at rest and during activity (eg, walking) and implement strategies to minimize the patient's pain during the treatment session to optimize the patient's mobility. Strategies may include appropriate timing of medication, consultation with the interprofessional team, and psychologically informed physical therapy approaches for nonpharmacological pain management.

Prevention of Pressure Ulcers

The following recommendation is based on best practice and a consensus recommendation from a high-quality CPG on hip fracture management and best practice.[199]

F Clinicians must screen for risk of pressure ulcers. Risk factors include significantly limited mobility, significant loss of sensation, a previous or current pressure ulcer, nutritional deficiency, the inability to reposition themselves, incontinence, and significant cognitive impairment.

Prevention of Falls

The following is based on strong recommendations from high-quality CPGs from the AAOS[10,36] and the Academy of Geriatric Physical Therapy.[15]

A Physical therapists must assess and document patient risk factors for falls and contribute to interprofessional management. Physical therapists should use published recommendations from the Academy of Geriatric Physical Therapy of the APTA to guide fall-risk management in patients with hip fracture to assess and manage fall risk.

Secondary Fracture Prevention

Although diagnosis and management of osteoporosis is outside the scope of physical therapist practice, current health care management of older adults with hip fracture often includes multidisciplinary clinical systems such as fracture liaison services that seek to identify and treat older adults with osteoporosis.[50] Physical therapists are in a position to contribute to such programs if they are available in their health care setting.

F Physical therapists should contribute to interprofessional care to ensure that older adults with hip fracture are appropriately evaluated and treated for osteoporosis and risk of future fractures.

Determination and Communication of Functional Assistance Requirements

Although it is consistent with the standard of care for physical therapists to support safe and optimal mobility of older adults with hip fractures by determining and communicating their functional status and needs, the GDT was unanimous in wanting to highlight this role within interprofessional teams by providing a recommendation. Therefore, the following recommendation is based on best practice.

F Physical therapists must provide guidance to the interprofessional team and patients on assistive devices and assistance level for transfers and ambulation for patients with hip fracture.

Identification of Individual Goals

The following recommendation is based on best practice and on a consensus recommendation from a high-quality CPG.[199]

F Physical therapists must elicit individual goals for recovery of function, which may include independent basic mobility, achieving prior level of function, return to prefracture residence, and activities to support long-term well-being. Goals should be reviewed and revised throughout the continuum of care.

TRANSITION OF CARE FROM THE INPATIENT SETTING

Care transition refers to moving a patient between settings and providers, and poor transitions are associated with poor patient experience and outcomes.[261] There was consensus on the GDT to highlight this important opportunity to improve care. The GDT identified a relevant consensus-based recommendation in a high-quality CPG for people with stroke.[201]

Recommendation

F Physical therapists should work collaboratively to contribute to interprofessional assessment and plan to ensure safe transfer from the hospital to the community. The assessment should:

- Identify any ongoing needs of the person and his or her family or caregiver
- Be documented and all needs recorded in the person's transition-of-care plan, with a copy provided to the person with hip fracture

Before transfer from the hospital to home or to a care setting, physical therapists discuss and agree on a physical therapy care plan with the person with hip fracture and his or her family or caregiver (as appropriate) and provide this to all relevant health care providers.

Before transfer of care from the hospital to home for people with hip fracture:

- Establish that the patient has a safe and enabling home environment; for example, check that appropriate equipment and adaptations have been provided and that caregivers are supported to facilitate independence
- Undertake or arrange a home visit unless the patient's abilities and needs can be identified in other ways, for example, by demonstrating independence in all self-care activities, including meal preparation, while in the rehabilitation unit

On transfer of care from the hospital to the community, the interprofessional team should provide information to all relevant health care providers and the person with hip fracture. This should include:

- Fracture type and surgical procedure
- A summary of rehabilitation progress and current goals
- Precautions and activity/exercise parameters (eg, weight-bearing status, dislocation/exercise/range-of-motion restrictions and progression guidance)
- Diagnosis and health status (eg, relevant medical and physical therapy diagnoses)
- Functional abilities (including communication and physical needs)
- Hip fracture–related pain assessment
- Care needs, including washing, dressing, help with going to the toilet, and eating
- Psychological (cognitive and emotional) needs
- Medication needs (including the person's ability to manage prescribed medications and any support needed to do so)
- Social circumstances, including caregivers' needs
- Understanding of the transfer decision

- Management of risk, including the needs of vulnerable adults
- Plans for follow-up, rehabilitation, and access to health and social care and voluntary sector services

After transfer of care from the hospital, people with continued impairments and functional deficits after hip fracture (including people in nursing homes) should receive evaluation within 72 hours by the facility or home care physical therapist.

CLINICAL PRACTICE GUIDELINES

Interventions

STRUCTURED EXERCISE

In this CPG, structured exercise refers to skilled, carefully designed exercise intervention targeting impairments, activity limitations, and/or participation restrictions. Such interventions include multiple components, such as progressive resistance training, balance training, functional mobility training, and weight-bearing exercises. The evidence for structured exercise interventions comes from systematic reviews and meta-analyses, in which relevant outcomes are reported as continuous variables, combined and standardized, and reported as the standardized mean difference (SMD) or effect size (ES). As a rough guide for the magnitude of SMDs and ESs, 0.2 is considered small, 0.5 is moderate, and 0.8 is large.[49]

Evidence

I A high-quality meta-analysis was conducted to investigate the effects of structured exercise on mobility after hip fracture.[66] This study included 13 clinical trials deemed of acceptable quality, with 1903 participants and overlapping combinations of high-intensity progressive resistance, balance, weight-bearing, and functional mobility training. The SMD for effects on mobility was 0.35 (95% CI: 0.12, 0.58). This study found that structured exercise programs provide small, clinically significant improvement in mobility. Univariate metaregression was used to explore the effects of trial-level variables and to report the effect of a 1-unit change in each variable on the SMD. Structured exercise programs with progressive resistance were more effective than those without (change in SMD, 0.58; 95% CI: 0.17, 0.98), and exercise provided in the hospital alone was less effective than exercises that were provided across settings. The effect for interventions provided outside the hospital setting was described as change in SMD (0.50; 95% CI: 0.08, 0.93). Diong et al[66] provided the following summary of study characteristics.

> "The mean (SD) dose of intervention across trials was 37 (31) hours, average follow-up time period was 12 (6) weeks, and average participant age was 80 (2) years. The trials examined overlapping combinations of structured exercise interventions: 5 trials examined high intensity exercise (3 trials high intensity progressive resistance, 2 trials high intensity physiotherapy), 4 trials examined home-based exercise (3 trials home-based, 1 trial home-based resistance), 5 trials examined weight-bearing exercise (3 trials weight-bearing, 1 trial early weight-bearing, 1 trial high intensity weight-bearing), 2 trials focused on resistance exercise (1 trial progressive resistance, 1 trial prolonged resistance), and 3 trials examined a combination of interventions (1 trial resistance or aerobic, 1 trial nutrition and resistance or resistance only, 1 trial exercise and motivation or exercise only). Interventions were supervised in 10 trials, contained a balance component in 7 trials, and contained a progressive resistance component in 6 trials. Interventions in 5 trials were delivered to participants only in hospital while interventions in 9 trials were delivered to participants in other settings (mixed hospital and community, or only community)."

I A second systematic review by Auais et al[14] investigated the effect of extended structured exercise provided beyond discharge from usual care (started approximately 1 to 9 months after hip fracture surgery) on physical function outcomes. There was significant overlap between the reviews of Auais et al[14] and Diong et al,[66] such that all except 3 of the studies in the review by Auais et al[14] were included in the review by Diong et al.[66] Significant, small to moderate ESs were found for knee extension strength of the affected side (ES, 0.47; 95% CI: 0.27, 0.66) and unaffected side (ES, 0.45; 95% CI: 0.16, 0.74), balance (ES, 0.32; 95% CI: 0.15, 0.49), physical performance–based tests (ES, 0.53; 95% CI: 0.27, 0.78), the TUG test (ES, 0.83; 95% CI: 0.28, 1.4), and fast gait speed (ES, 0.42; 95% CI: 0.11, 0.73). Differences were not found for normal gait speed, the 6MWT, ADL and instrumental ADL, and the physical functioning subscale of the SF-36. Community-based programs had larger ESs compared with home-based programs. A summary of program characteristics is provided in **TABLE 5**.

Balance Training

I Lee et al[174] conducted a systematic review and meta-analysis of balance training after hip fracture and included 8 trials (n = 752). There was substantial overlap between the studies included in the review by Diong et al[66] (described above) and this review; however, there were some differences. Whereas Diong et al[66] did not find a statistically significant effect of including a balance component, Lee et al[174] found significant effects across domains of function. The estimates of effect for the 2 studies are provided in **TABLE 6**. Smaller ESs found in the review by Diong et al[66] could be explained by the comparative approach, in which the authors compared trials of balance interventions with trials of other structured exercise interventions. Recent meta-analyses by Chen et al[45] and Wu et al[275] had substantial overlap with the review by Lee et al.[174] Effect sizes were all consistent with those provided by Lee et al,[174] and although there was variation in point estimates, ESs were in the moderate-to-large range.

Progressive Resistance Training

I

Lee et al[175] conducted a systematic review and meta-analysis of progressive lower extremity resistance training compared to control or standard care after hip fracture surgery that included 8 randomized controlled trials (RCTs) (n = 587), with follow-up duration ranging from 3 months to 1 year. There was overlap in only 3 trials between the reviews by Diong et al[66] and Lee et al.[175] Compared to control/standard care, progressive resistance training significantly improved older adults' physical function (SMD, 0.41; 95% CI: 0.24, 0.58), mobility based on any gait measure such as gait speed (SMD, 0.50; 95% CI: 0.30, 0.70), ADL (eg, Nottingham Extended Activities of Daily Living Scale, FIM, Katz Index of Independence in Activities of Daily Living) (SMD, 0.24; 95% CI: 0.04, 0.44), balance (SMD, 0.55; 95% CI: 0.31, 0.80), lower-limb strength or power (SMD, 0.42; 95% CI: 0.10, 0.74), and physical performance measures (SMD, 0.84; 95% CI: 0.20, 1.48). However, self-reported physical function did not differ significantly between approaches (SMD, 0.45; 95% CI: –0.06, 0.96). The ESs for progressive resistive exercise in the review by Lee et al[175] are similar to those of the reviews by Diong et al[66] and Auais et al[14] and can be seen in **TABLE 6**.

I

Kronborg et al[165] investigated the addition of daily progressive resistance training for knee extension of the fractured limb (using a 10-RM design with weight loads adjusted on a set-to-set basis) during the acute inpatient stay for 90 older adults with hip fracture. The outcomes were measured at discharge from the inpatient hospital or at follow-up 10 days after surgery. Though the intervention group had 8% more improvement than the control group, the difference was not significant (95% CI: –2.3%, 18.4%). The authors posed the question of whether the extremely short duration of intervention (5 days) and outcome follow-up measurement (10 days) limited their ability to detect a larger difference.

II

Stasi et al[247] investigated intensive hip abductor training, beginning 4 weeks after surgery, compared to usual physical therapy, which included low-intensity, slow progression of strength training, in an RCT of 96 patients with hip fracture. No baseline data were reported, but the authors found significantly better strength and function in the intervention group compared to the control group at the completion of the program. At 6-month follow-up, abductor isometric strength was 37.0% greater and the abductor ratio was 7.1% higher in the intervention group compared to the control group. Similarly, the intervention group was 45.9% faster during the TUG test and achieved an 11.2% higher lower extremity function score.

Treadmill Training

II

van Ooijen et al[268] investigated conventional treadmill training, adaptability treadmill training, and usual physical therapy among older adults with recent hip fracture in an inpatient rehabilitation setting. Adaptability treadmill training consisted of virtual projection of objects on the treadmill in the path of the individual. Exercises entailed "visually guided stepping to a sequence of regularly or irregularly spaced stepping targets" with or without obstacle avoidance and speed changes. Usual physical therapy, conventional treadmill training, and adaptability treadmill training groups received a total of 30 visits. The usual physical therapy group received 30 sessions that included strength, balance, and mobility training. The conventional treadmill training group received 15 usual physical therapy sessions and 15 conventional treadmill training sessions. The adaptability treadmill training group received 15 conventional treadmill training sessions and 15 adaptability treadmill training sessions. Among 13 outcomes and 3 measurement time points, differences between groups were found, favoring both treadmill training groups for 2 outcomes: (1) an observation-based walking rating at completion of the intervention (6 weeks) and at 4-week follow-up, and (2) dual-task walking at 6 weeks.

II

Oh et al[206] conducted an RCT comparing the addition of 20 minutes of antigravity treadmill training to 30 minutes of "standard physical therapy" among patients with hip fracture and sarcopenia, and found improved walking ability and balance at 3 weeks and at 3 and 6 months.

HOME-BASED EXERCISE

Home-based exercise, as defined in the studies included and reviewed hereafter, included any type of exercise performed in the home. It was not specific to skilled physical therapist–led exercise. Supervised sessions were conducted by physical therapists or exercise trainers, and varied in number from 2 to 56 sessions for a duration of 10 to 52 weeks. Trials started as early as 2 months after fracture and as late as 9.5 months after fracture.

I

Kuijlaars et al[167] conducted a systematic review and meta-analysis of 6 trials (n = 602) investigating home-based exercise compared to usual care or control, and found limited evidence for short-term (less than 4 months) and long-term (greater than 4 months) effects on physical performance measures; short-term effects on balance, endurance, and mobility; and long-term effects on gait. They found conflicting evidence for strength, long-term balance, short-term gait (comfortable), long-term self-reported

ADL, and long-term mobility, and concluded that for most outcomes, there was no evidence for home-based exercise after hip fracture. Results from post hoc analysis by Auais et al[14] also found no significant effect for the majority of outcomes and smaller ESs for home-based than for community-based exercise in their systematic review. In contrast, Wu et al[274] conducted a systematic review and meta-analysis of home-based rehabilitation for older adults with hip fracture and found statistically and clinically significant differences compared to usual care for several outcomes (**TABLE 7**).

These analyses are confounded by several important factors. First and foremost, the difference between the intervention and "usual" or "standard" care was not evident: usual care varies and may be more similar to the intervention than anticipated. For example, in a study of the Geriatric Interdisciplinary Home Rehabilitation program,[139,140] the usual-care group received multidisciplinary rehabilitation that included home rehabilitation, making it unclear what the essential differences were between intervention and control conditions. Therefore, the percent of patients in each group receiving all types of related care and the number of visits should be documented and reported. Second, the conceptual bases for the interventions are different across studies included in these systematic reviews. Several studies were designed to assess the impact of early discharge home from inpatient care compared to continued rehabilitation in inpatient settings, whereas other studies focused on extended services after usual discharge. In the case of early discharge home with rehabilitation services, findings of no difference in outcomes may be a more favorable outcome than in the case of extended services. Related to this issue are the substantial differences in the timing of intervention and its relationship to usual care. Studies occurring immediately after discharge from an inpatient setting will be far more likely to include active, multidisciplinary rehabilitation and home exercise instruction in the usual- or standard-care group. Lack of clarity in differences between home-based rehabilitation and home exercise instruction and between skilled rehabilitation and training provided by alternative providers was also evident in the trials and systematic reviews in this area. Finally, there was significant variation in the interpretation of various concepts related to functioning (eg, mobility, ADL) such that, for example, relevant outcomes were omitted from analysis in the review by Wu et al,[274] and relevant studies were omitted from the Kuijlaars et al[167] review. Although these reviews were conducted using acceptable systematic review methods, the questions were not specific enough (as formulated) to yield useful answers. These issues are addressed below in the Gaps in Knowledge section.

SUMMARY OF EXERCISE PARAMETERS

Functional mobility training was described as changing and maintaining body position/transfers and ambulation using a range of approaches. For progressive resistive and balance training and weight-bearing exercise that provided adequate description of exercise parameters, these characteristics are summarized in **APPENDIX J** (available at www.jospt.org).

Evidence Synthesis

The results of the Diong et al[66] meta-analysis indicate that structured, multimodal exercise intervention provides clinically significant, small to moderate effects on mobility. The results of the review by Auais et al[14] were consistent with those of Diong et al,[66] with larger ESs and an especially large effect for the TUG test, a measure with indication of mobility and fall risk. Further systematic reviews by Lee et al[174,175] specific to exercise type (balance, progressive strength training) also found significant treatment effects. An important issue considered in this recommendation is additional potential benefits through prevention of subsequent falls and fractures. The combined impact of the incremental improvements across domains of outcome supports a preponderance of benefit for these interventions, making the GDT interpret that the magnitude of effect on the individuals is larger than what was found in the review by Diong et al.[66] Therefore, the recommendation for structured exercise is strong, based on level I evidence. The findings in 2 systematic reviews that ESs were small or not statistically significant for home-based exercise were weighed against analyses specific to an exercise component, and given the concerns about confounding by timing, exercise intensity, and sample characteristics in the home-based setting and the possibility of creating disparities in health services, the GDT determined that further research would be needed to exclude older adults in the home from the recommendation. These studies did not investigate different exercise doses/parameters; therefore, specific dosing recommendations could not be provided. However, for studies that provided adequate description of exercise parameters, these characteristics were summarized in **APPENDIX J** to provide therapists with information to support decision making on exercise type and dose. Conceptual confusion, lack of clarity regarding comparison interventions, and wide variation in timing precluded the use of evidence from systematic reviews of home-based rehabilitation and exercise. Therefore, no recommendation was provided specific to home-based rehabilitation. There was insufficient evidence to support a recommendation related to treadmill training.

Gaps in Knowledge

In studies of interventions for older adults with hip fracture, new interventions are often compared to "usual" or "standard" therapy. Researchers must specify the components of the intervention and the dose, including frequency, intensity, time, and type, for both groups. For multidisciplinary and/or interprofessional interventions, researchers must report the percent receiving visits and the number of visits for both groups. Researchers should clarify the intent of the trial relative to (1) replacing existing services with new services, (2) extending/adding services, (3) distinguishing between skilled rehabilitation and training provided by alternative providers, and (4) distinguishing between providing rehabilitation and home program instruction. Researchers should also report when the intervention occurs relative to hip fracture.

Recommendation

A Physical therapists must provide structured exercise, including progressive high-intensity resistive strength, balance, weight-bearing, and functional mobility training, to older adults after hip fracture.

STRUCTURED EXERCISE FOR OLDER ADULTS WITH COGNITIVE IMPAIRMENT

III A systematic review by Allen et al[7] compared the evidence of rehabilitation interventions on function, ambulation, discharge location, and incidence of falls in participants with mild to moderate dementia and in those without cognitive impairment who sustained a hip fracture. Thirteen articles reporting on secondary analyses of outcomes for individuals with versus without cognitive impairment met the inclusion criteria. This review of observational data came from 5 RCTs and 8 cohort studies and was classified as level III evidence. The studies took place in early postoperative inpatient settings. The participants, interventions, and outcomes were so diverse that a meta-analysis could not be completed. The physical therapy portion of the interventions consisted of strength training, range-of-motion training, gait and transfer training, and participation in self-care activities. For the outcome of function, 8 studies were included, and the FIM and Barthel index were the most commonly reported measures. There was no effect of cognition on functional recovery. Older adults with cognitive impairment were as likely as those without to return to their prior living situation. There were 5 studies that used ambulation as the outcome, and there were 5 different measures of ambulation. Across the studies, participants with mild to moderate dementia made similar gains in ambulation compared to those without cognitive impairment.

III Two systematic reviews[47,245] and a recent review update[244] attempted to address the effectiveness of interventions for people with cognitive impairment who sustained a hip fracture. Chu et al[47] targeted community-based intervention and Smith et al[244,245] targeted "enhanced rehabilitation." There was overlap in the studies included, but the findings were similar in that no studies directly addressed the question. Outcomes were not the same across studies and covered a wide range of constructs. There were statistically significant improvements in mobility and ADL for patients with cognitive impairment who had been randomized to the intervention versus those who had not in the 2 studies that measured these outcomes, and evidence of shorter hospital length of stay and higher likelihood of returning home in the short term (3 months). However, the evidence was deemed low or very low quality due to risk of bias.

Evidence Synthesis and Rationale

Persons with mild to moderate dementia who received rehabilitation show similar relative gains in function to patients without dementia. Although this recommendation is based on indirect, low-level evidence, the strength of the recommendation was raised due to lack of evidence for not providing similar care and a preponderance of benefits of interventions combined with potential substantial harms from not providing similar intervention care. Therefore, the recommendation for structured exercise is moderate, based on level III evidence.

Gaps in Knowledge

More research is required to determine the magnitude of the effect of physical therapy in patients with dementia following hip fracture across all settings. In particular, investigation is needed on the impact of physical therapy structured exercise interventions in residential care settings, where prevalence of cognitive impairment is high and individuals may have capacity to improve mobility.

Recommendation

B Clinicians should provide physical therapy/rehabilitation to patients with mild to moderate dementia, using similar interventions and prescriptions as for those without dementia.

EARLY POSTOPERATIVE PERIOD/INPATIENT SETTING

Interprofessional Rehabilitation Programs

Evidence

I Bachmann et al[16] conducted a systematic review of 17 studies (n = 4780) of multidisciplinary rehabilitation designed for older adults, including "multidimensional geriatric assessment, assignment to therapy, and intervention team meetings for goal setting."[16] This included "general geriatric care" for older adults with a range of conditions, and "orthogeriatric care" that was specific to older adults with hip fractures, and was compared to standard inpatient care. They found benefits at time of discharge, including lower mortality (relative risk [RR] = 0.72; 95% CI: 0.55, 0.95) and admission to nursing home (RR = 0.64; 95% CI: 0.51, 0.81) and better physical function (odds ratio [OR] = 1.75; 95% CI: 1.31, 2.35). At 3- to 12-month follow-up, the RR for mortality was 0.87 (95% CI: 0.77, 0.97) and for nursing home admission was 0.84 (95% CI: 0.72, 0.99), and the OR for physical function was 1.36 (95% CI: 1.07, 1.71). Considering only the 9 studies of orthogeriatric rehabilitation for older adults with hip fracture, at discharge the OR for functional improvement was 2.33 (95% CI: 1.62, 3.34), the RR for admission to a nursing home was 0.72 (95% CI: 0.56, 0.91), and the RR for mortality was 0.66 (95% CI: 0.42, 1.04); at 3- to 12-month follow-up, the OR for functional improvement was 1.79 (95% CI: 1.24, 2.60), the RR for nursing home admission was 0.79 (95% CI: 0.61, 1.02), and the RR for mortality was 0.77 (95% CI: 0.61, 0.96). Lin et al[180] focused on "comprehensive geriatric care" in their 2020 meta-analysis of randomized trials. There was overlap between the reviews by Bachmann et al[16] and Lin et al,[180] and the findings were consistent for mortality and functional outcomes. Lin et al[180] found that comprehensive geriatric care resulted in decreased overall mortality (OR = 0.71; 95% CI: 0.53, 0.95) and increased function (SMD for ADL, 0.29; 95% CI: 0.12, 0.47).

I One high-quality CPG recommended multidisciplinary management, based on a systematic review and economic evaluation.[199]

I Crotty et al[58] investigated extending in-hospital comprehensive geriatric care, including physical therapy services, to patients with hip fracture returning to nursing care facilities in a large RCT. The combination of physical therapy and other services encompassed a total of 13 hours. At 4 weeks, the intervention group had better mobility than the usual-care group, though the ES was small. Additional outcomes and time points were limited by losses to follow-up and poor proxy-reporting validity. It is unclear how this intervention would translate to settings where multidisciplinary care is provided in nursing facilities, such as in the United States.

II The Trondheim Hip Fracture Trial[252,254,257] compared comprehensive geriatric care to usual orthopaedic care in the preoperative and early postoperative period and included 397 Norwegian patients with new hip fracture who had been living in the community and who were able to walk prior to the fracture. The intervention included enhanced interprofessional communication and services, including team meetings, goal setting, and collaboration. Orthopaedic care included care provided by different disciplines. Both groups received physical therapy tailored to patient needs. The comprehensive geriatric care program included a physical therapist and nurse "mobilization plan" from the first postoperative day and progressed thereafter each day. Physical therapists placed specific focus on patients who did not progress as expected, considering their prefracture functional status and type of surgery. Mobilization and physical therapy approaches were not described in the orthopaedic care program. Gait speed and symmetry and self-reported mobility at 4- and 12-month follow-ups were significantly more improved for the comprehensive geriatric care group than for the usual orthopaedic care group.[257] Taraldsen et al[252] reported on physical activity on the fourth postoperative day for 317 patients who used accelerometers. Patients participating in the comprehensive geriatric care program had better lower-limb function (evaluated with the SPPB) and more upright time (mean, 57.6 versus 45.1 minutes; P = .016), but there was no difference in the level of assistance needed for ambulation (evaluated using the CAS) compared to the orthopaedic care group. In a smaller sample of patients who used the activity monitors at 4 (n = 283) and 12 (n = 253) months, the intervention group had approximately 35 and 28 minutes more upright time at 4 and 12 months, respectively, than the usual orthopaedic care group.[254]

II A lower-quality systematic review of coordinated multidisciplinary inpatient rehabilitation compared to usual orthopaedic care conducted by Halbert et al[99] included 11 studies published between 1986 and 2005, with a total of 1949 patients. The majority of studies included in the systematic review described early mobilization/ambulation and physical therapy as part of their program. They reported a lower risk of a "poor outcome," defined as dying or admission to a nursing home at discharge (risk ratio = 0.84; 95% CI: 0.73, 0.96), and a potentially higher likelihood of return home (risk ratio = 1.07; 95% CI: 1.00, 1.15).

II Lockwood et al[183] conducted an RCT (n = 77) comparing the addition of predischarge home visits to assess mobility, self-care, and household safety during observation of task performance in the home environment, using the Home Falls and Accidents Screening Tool to assess inpatients with hip fracture. Occupational therapists provided education, advice, and recommendations on equipment, home adaptations, and community support services. Patients in the intervention group experienced fewer 30-day readmissions (intervention, n = 1; control, n = 10; OR = 12.9; 95% CI: 1.5, 99.2). The most common reasons for readmission were falls and functional decline.

III Stenvall et al[249] conducted a secondary analysis of data from an RCT of comprehensive geriatric care with early transfers and ambulation for people with hip fracture (a subgroup with dementia, n = 64). The multidisciplinary, multicomponent intervention included daily functional mobility training and was compared to usual care. At 4 months, with follow-up data for 56 patients, there were no differences between the 2 groups on several physical function measures. However, 80% of the intervention group, compared to 7% of the control group, had regained their independent walking ability (P = .005). At 12 months (n = 45), 53% in the intervention group had regained the ADL performance level they had before the fracture, compared to 21% in the control group (P = .027).

III Scheffers-Barnhoorn et al[236] conducted a cluster RCT in inpatient rehabilitation units in the Netherlands to assess the impact of a multicomponent cognitive behavioral intervention, integrated by physical therapists into treatment after surgery for hip fracture, on falls self-efficacy. No differences were found between groups in physical performance, falls efficacy, or self-reported activity restriction. However, the study was underpowered and raised questions about the natural history and mechanisms of action of fear of falling in older adults with hip fracture.

Evidence Synthesis and Rationale

Strong evidence from systematic reviews comparing health care delivery models was found for better outcomes with multidisciplinary management, including orthopaedic and geriatric specialist care, multidimensional geriatric assessment, assignment to therapy, and intervention team meetings for goal setting. Components of successful programs included a focus on "early mobilization." Therefore, the recommendation is strong, based on level I evidence.

Gaps in Knowledge

Research is needed to better describe the specific components of the programs, including usual care, to better understand the impact of intensity, frequency, and duration of programs.

Recommendation

A Older adults with hip fracture should be treated in a multidisciplinary orthogeriatric program that includes physical therapy and early mobilization.

FREQUENCY OF PHYSICAL THERAPY

Evidence

II Lauridsen et al[172] evaluated the effect of "intensive" (2 h/d, 3 d/wk) versus standard (15-30 minutes each weekday) physical therapy in 88 participants who were transferred to an inpatient rehabilitation setting within 3 weeks after surgery. Although they found no difference in functional outcomes between the 2 groups, those who adhered to their physical therapy program experienced better outcomes (90% were able to walk with 1 or 2 "walking sticks" at discharge, compared to 35% of those who did not complete their program). However, 24/44 failed to complete the program in the "intensive" group, compared to 13/44 in the standard group (RR = 1.85; 95% CI: 1.09, 3.14). Two hours of physical therapy in a day (possibly in 1 session) on 3 weekdays seem to exceed the capacity of many patients at this time point after hip fracture surgery, and therefore cannot be recommended.

II Bischoff-Ferrari et al[25] randomized patients with hip fracture into 4 groups to investigate vitamin D dose (800 and 2000 units) and 30 minutes of additional physical therapy instruction per day in a home exercise program during acute hospitalization, compared to standard physical therapy (30 minutes per day when in the acute hospital), in 173 patients. Patients in the additional physical therapy group were provided with a home exercise instruction sheet and instructed to perform exercises for 30 minutes per day. They found that additional instruction reduced the rate of falls by 25% (95% CI: 1%, 44%) in adjusted analysis within the 1-year follow-up. There was also a tendency toward fewer fall-related injuries (47%; 95% CI: –20%, 77%). More recently, Renerts et al[225] reported on HRQoL for the same study and found no benefit of additional exercise instruction, while Stemmle et al,[248] although underpowered for these secondary outcomes, reported on strength and the TUG test of mobility. They found more improvement in the TUG test for the group with 800 units of vitamin D and additional exercise instruction compared to vitamin D alone, but no difference for additional exercise instruction between the groups who received 2000 and 800 units of vitamin D.

II The study by Kimmel et al[145] evaluated the effects of more frequent acute hospital physical therapy in 92 patients with hip fractures. Patients were randomized to frequent physical therapy (3 times daily; intervention group) or usual-care physical therapy (daily; control group) for 1 week during acute hospitalization. Although there was no difference in the primary functional measure between groups at postoperative day 5, the more frequent physical therapy group had shorter combined inpatient length of stay (acute plus postacute) and, importantly, reached functional discharge criteria a median of 11 days earlier than the control group.

Evidence Synthesis and Rationale

Level II evidence from RCTs of moderate quality indicate that daily physical therapy is better tolerated than longer, less frequent physical therapy sessions. Only 1 study[172] addressed intensity of physical therapy in the postacute inpatient setting.

Gaps in Knowledge

Additional research is needed to understand the optimal frequency and intensity of physical therapy in the postacute inpatient setting.

Recommendation

B Patients should be offered high-frequency (daily) in-hospital physical therapy following surgery for a hip fracture, with duration as tolerated, including instruction in a home program.

EARLY ASSISTED TRANSFERS AND AMBULATION

Evidence

II One high-quality CPG from the National Institute for Health and Care Excellence in the United Kingdom[199] recommended "mobilization" on the day after surgery and at least once a day, based on a systematic review demonstrating improved transfers and ambulation distance within 7 days. It was also noted that "early restoration of mobility after surgery for hip fracture has been suggested as an essential part of high-quality care since the early 1980s."[199]

II Oldmeadow et al[208] assessed the effects of early assisted ambulation (the first walk on postoperative day 1 or 2) compared to delayed assisted ambulation (allowed to transfer to a chair, but the first walk occurred on postoperative day 3 or 4) after surgery among 60 participants (2 groups of 30) in an acute hospital setting. Ten participants in the early ambulation group failed to start walking until after 48 hours. At 1 week after surgery, the early ambulation group required less assistance for transfers and ambulation, and walked farther. The early ambulation group had a higher likelihood of discharge to home (26.3%) than the delayed ambulation group (2.4%). The delayed ambulation group was also more likely to require "high-level care" (56% compared to 36.8%).

Evidence Synthesis and Rationale

Although there is limited evidence from RCTs to support early assisted transfers and ambulation (also called "mobilization"), it is an essential component of best practice for older adults with hip fracture. Clinical trials with serious limitations reviewed in the National Institute for Health and Care Excellence CPG[199] and including the study by Oldmeadow et al[208] measured outcomes at 7 days after surgery up to discharge from the acute-care hospital. However, performing further RCTs specifically evaluating the effect of early versus delayed ambulation after hip fracture surgery is not considered ethically sound, due to the negative association with immobilization following hip fracture. Therefore, based on level II evidence, a relevant high-quality CPG, and a preponderance of benefit, the GDT provides a strong recommendation for assisted transfer out of bed and ambulation as soon as possible after hip fracture surgery, unless contraindicated for medical or surgical reasons.

Recommendation

A Clinicians must provide assisted transfer out of bed and ambulation as soon as possible after hip fracture surgery and at least daily thereafter, unless contraindicated for medical or surgical reasons.

AEROBIC EXERCISE ADDED TO STRUCTURED EXERCISE

Evidence

II Mendelsohn et al[191] investigated a 4-week arm ergometer aerobic program in addition to standard physical therapy conducted in the inpatient postacute setting. This small RCT (n = 20) found no adverse events reported, and there was very high adherence to the program (97%). The training group demonstrated significantly better cardiorespiratory fitness as measured by peak oxygen consumption, as well as better results for the TUG test and Berg balance scale, at the completion of the 4-week program compared to standard physical therapy alone. The participants performed upper-body cycle ergometry for 20 minutes a session, 3 times per week, for 4 weeks. The intensity was 65% of maximum oxygen consumption (peak VO_2). Average workloads ranged from 11 to 45 W. Peak VO_2 was determined by indirect calorimetry during an incremental exercise test on a custom-built arm crank ergometer. The cadence was 60 revolutions per minute and the work rate was increased every minute until volitional fatigue.

Evidence Synthesis and Rationale

This small clinical trial provides preliminary evidence of safety and efficacy of upper-body aerobic training in the inpatient postacute period/setting. Aerobic fitness has a wide range of physical and mental health benefits and supports functional activities and participation, and therefore a weak recommendation below is made, based on level II evidence and a preponderance of benefits.

Gaps in Knowledge

A larger clinical trial is warranted to address remaining uncertainty due to small sample size, which should include longer-term follow-up.

Recommendation

C Physical therapists may provide upper-body aerobic training in addition to progressive resistive, balance, and mobility training in the early postacute period/inpatient setting for older adults after hip fracture.

UPPER-BODY YOGA

Evidence

II One RCT[95] investigated the effect of upper-body yoga compared to breathing exercises in 89 patients for the first 4 weeks after surgery for hip fracture on spirometer-based forced breathing capacity and peak cough capacity and physical function. The intervention, which combined upper-body movement with breathing exercises, was associated with small, statistically significant improvements in each outcome.

Gaps in Knowledge

Further research is needed to increase confidence in the accuracy and magnitude of benefit.

ELECTRICAL STIMULATION FOR QUADRICEPS STRENGTHENING

Evidence

II Lamb et al[170] included 24 women (1 week after surgery for hip fracture) in an RCT of electrical stimulation of the quadriceps muscle (3 h/d for 6 weeks). The stimulation parameters were the minimum required to see a visible contraction of the muscle. The placebo group received a strong stimulus but negligible muscle activation. At 7 weeks, there were no differences between groups, but at 13 weeks, 75% of the intervention group recovered to their prior level of indoor mobility, while only 25% recovered in the placebo group.

II Braid et al[33] included 26 patients (10 days after fracture) in an RCT in which electrical stimulation was given for 18 minutes, 5 days per week as an inpatient and twice weekly once discharged (median, 10 sessions) for 6 weeks. The control group received usual physical therapy. Stimulation intensity increased every session, according to the participant's tolerance, to achieve maximal quadriceps contraction without causing discomfort locally. No between-group difference in the change of leg extensor power or any other outcome measure was found. Only 3 (20%) participants in the electrical stimulation group tolerated sufficient current intensity to produce repetitive knee extension, while 11 (73%) sustained palpable or visible contraction with no leg movement.

Evidence Synthesis and Rationale

The 2 studies had conflicting findings and had different approaches. Braid et al[33] found no effect but also had a much smaller dose of intervention than did the study by Lamb et al.[170] Lamb et al[170] provided some evidence that electrical stimulation improved mobility and that the effect persisted, even increased, after the end of the 6-week regimen. However, 3 hours of electrical stimulation per day is likely not feasible for patients to receive or for providers to deliver. Poor tolerance of electrical stimulation was found by Braid et al,[33] but not by Lamb et al.[170] It is possible that the difference in the findings of the 2 trials mainly reflects differences in the stimulation regimens.[33] Therefore, the recommendation is weak, based on level II evidence.

Braid et al[33] found no evidence of an effect (compared with no stimulation) but also noted poor tolerance of electrical stimulation. In contrast, Lamb et al[170] found a greater recovery of prefracture mobility for electrical stimulation (compared with placebo stimulation), which was fairly well tolerated by the trial participants.

Gaps in Knowledge

Contradiction in the findings between the studies by Braid et al[33] and Lamb et al[170] calls for studies to investigate the optimal parameters to improve tolerance of stimulation. As the studies by Lamb et al[170] and Braid et al[33] are underpowered, future studies should include more participants. Further, studies should have a follow-up period of 6 months or more to determine long-term effects.

Recommendation

C Physical therapists may use electrical stimulation for quadriceps strengthening if other approaches have not been effective.

ELECTRICAL STIMULATION FOR PAIN MANAGEMENT

Evidence

II Abou-Setta et al[2] conducted a systematic review of preoperative pain management approaches, including transcutaneous electrical nerve stimulation (TENS). Although TENS was found to be safe and statistically significant reductions in pain were shown, evidence was limited by a high risk of bias.

II A study by Gorodetskyi et al[90] included patients who were cognitively intact and had a trochanteric hip fracture, randomized to either physical therapy plus TENS or physical therapy plus sham TENS. They found a statistically and clinically significant reduction in pain and favorable results for pain interference during walking and hip flexion at 10 days after surgery in the intervention group. The stimulation device measured the impedance of the tissue and provided variable voltage to maintain constant current; the intensity was set to produce a comfortable sensation for a daily duration of 20 to 30 minutes. Electrode placement was just above the primary surgical incision, the buttock area posterior to the hip, and the anterior superior iliac spine. Similarly, Elboim-Gabyzon et al[71] conducted a small RCT ($n = 41$) in 1 hospital of TENS compared to sham in addition to usual care for the first 5 days after surgery for hip fracture. They found significantly larger reduction in pain while walking and improvement in functional ambulation scores and walking distance on day 5 compared to day 2. The mean ± SD magnitude of reduction in pain (0-to-10-point scale) for the intervention and sham groups was 2.55 ± 1.37 versus 1.06 ± 1.11, respectively.

Evidence Synthesis and Rationale

Evidence supports the safety of TENS and a potentially clinically meaningful reduction in pain during movement in the early postoperative period. The risk of bias in the studies is somewhat balanced by consistency in results, which showed a statistically significant decrease in pain, improved walking, and no evidence of harms.

Gaps in Knowledge

The recommendation is weak, based on level II evidence. Larger-scale testing is needed to further investigate the potential benefits of TENS on length of hospital stay and mobility. Future studies should include older adults with all types of hip fracture and a follow-up period of 3 months or more.

Recommendation

C Physical therapists may use electrical stimulation for pain if it is not sufficiently managed with usual strategies.

POSTACUTE PERIOD: HOME CARE AND COMMUNITY SETTINGS

Extended Exercise

Evidence

I Auais et al[14] conducted a systematic review to examine extended exercise rehabilitation beyond discharge from usual care in older adults after hip fracture. The studies used community- or home-based programs. Only RCTs published from 1997 to 2012 with physical function outcome measures were included. A total of 11 trials (1107 participants) were included in the final analysis, of which 7 studies were conducted in the home setting. The home-based studies started the intervention as early as 22 days post fracture and up to 7 months post fracture. Exercise dose ranged from 3 to 56 sessions over a period of 1 to 12 months. The interventions described were weight-bearing exercises, including step-ups, progressive resistive exercises, aerobic training, functional training, and balance activities. Significant, small to moderate ESs were found for knee extension strength (affected side, 0.47; 95% CI: 0.27, 0.66; unaffected side, 0.45; 95% CI: 0.16, 0.74), balance (0.32; 95% CI: 0.15, 0.49), physical performance–based tests (0.53; 95% CI: 0.27, 0.78), the TUG test (0.83; 95% CI: 0.28, 1.4), and fast gait speed (0.42; 95% CI: 0.11, 0.73). No significant differences were found for normal gait speed, the 6MWT, ADL and instrumental ADL, and the PF-10 of the SF-36. In subgroup analyses, community-based programs demonstrated larger ESs compared with home-based programs (**TABLE 8**).

I Turunen et al[265] investigated the addition of a 12-month home-based program to standard care, consisting of assessing and addressing environmental hazards, guidance for safe walking, nonpharmacological pain management, a progressive home exercise program, and physical activity counseling. The exercise program was provided by a physical therapist over 5 to 6 home visits. The program was initiated an average ± SD of 42 ± 23 days after discharge from the hospital. The intervention group demonstrated significantly more improvement in physical activity level than the control group, as measured by number of inactive participants at completion of the home visits, number engaging in moderate-to-vigorous activity at 12 months, and number of participants who increased their level of physical activity.

II Magaziner et al[187] conducted a large RCT of additional multicomponent intervention conducted by physical therapists in the home beginning 10 to 18 weeks after hospitalization for hip fracture. The intervention included progressive balance, strength, and mobility training. Both groups received vitamin D and nutrition counseling. There was an active control intervention that consisted of range-of-motion exercises and lower extremity TENS, conducted by a physical therapist. There were no differences between the groups in the primary outcome of ambulatory walking or in the secondary outcomes. However, some limitations impact the interpretation of this trial. The study was powered for a large (20%) difference between groups; therefore, a difference smaller than 16% cannot be ruled out, and the control group in this trial appeared to improve more in other trials with less active control interventions, raising the question of whether the interaction with the physical therapist could have motivated the control group.

II Taraldsen et al[253] conducted an RCT of a 10-week, home-based balance and gait training program initiated 4 months after hip fracture in addition to usual care. Although there was significant loss to follow-up, the intervention group demonstrated a significant difference in mean gait speed. The difference was 0.09 m/s (95% CI: 0.04, 0.14) after the intervention and 0.07 m/s (0.02, 0.12) at 12-month follow-up. There were no differences in physical performance and mobility measures.

II In their RCT, Resnick et al[226] assessed the effect of a 12-month program of trainer-led exercise sessions plus self-efficacy training compared to no intervention on self-efficacy, outcome expectations, and exercise behavior. Those who participated in the program exercised more hours per week at 6 and 12 months compared to those who did not. There were no differences in change in self-efficacy or outcome expectations between groups.

III Williams et al[271] conducted a preliminary feasibility study of a multidisciplinary intervention, including goal setting and targeted activities focused on self-efficacy, and 6 additional physical therapy visits in North Wales, UK. Although there were no differences in most outcomes between the 2 groups, the intervention group showed moderate improvement on the Nottingham Extended Activities of Daily Living Scale compared to the control group (adjusted mean difference, 3.0; Cohen's d = 0.63). There was a trend of greater improvement in falls self-efficacy and anxiety/depression.

Evidence Synthesis and Rationale

Following acute management of hip fracture, there is level I evidence that patients who participate in progressive resistance training or high-intensity weight-bearing exercises show moderate gains in various outcome measures across domains of functioning, such as lower extremity strength, physical performance (eg, TUG test), and self-reported physical function. Gains were not as large when studies were conducted in the home setting as compared to outpatient or other community-based settings. One study found no impact of extended home-based therapy, but design issues left open the question of a false-negative result. There are several important factors that could account for these differences, including timing relative to the hip fracture, older adult characteristics (eg, presence of depression or frailty), dose of skilled intervention, access to specialized equipment, and social factors.

Gaps in Knowledge

The frequency and duration of interventions varied widely across the studies, which makes it difficult to determine an adequate dose. Additional research investigating the dose associated with functional improvement is needed.

Recommendation

A Clinicians must provide opportunities for additional therapies if strength, balance, and functional deficits remain beyond 8 to 16 weeks after fracture. The additional therapies should include strength, balance, functional, and gait training to address existing impairments and activity limitations and fall risk. They may include outpatient services, a progressive home exercise program, or evidence-based community exercise programs such as those identified by the US Centers for Disease Control and Prevention and the National Council on Aging.

EVIDENCE-BASED COMMUNITY EXERCISE AND PHYSICAL ACTIVITY PROGRAMS

- https://www.ncoa.org/resources/ebpchart/
- https://www.ncoa.org/center-for-healthy-aging/basics-of-evidence-based-programs/physical-activity-programs-for-older-adults/

FALL PREVENTION PROGRAMS

- https://www.ncoa.org/healthy-aging/falls-prevention/falls-prevention-programs-for-older-adults-2/
- https://www.cdc.gov/homeandrecreationalsafety/falls/compendium.html

PHYSICAL ACTIVITY INTERVENTIONS

This section describes current general recommendations from the US Department of Health and Human Services (DHHS), followed by the GDT review of evidence specific to older adults with hip fracture. The DHHS has made recommendations for physical activity for adults with chronic conditions or disabilities,[266] based on systematic reviews of evidence.[1] The Advisory Committee reported evidence from large numbers of peer-reviewed studies supporting the health benefits of moderate-to-vigorous physical activity and minimizing physical inactivity. Evidence shows that higher physical activity levels are associated with improved physical function and sleep quality, decreased anxiety, temporary improvements in cognitive function, and lower risk for a wide range of chronic conditions. The committee noted that "physical activity-related benefits also have been demonstrated for the large number of individuals who already have one or more chronic conditions, such as osteoarthritis, hypertension, type 2 diabetes, dementia, multiple sclerosis, spinal cord injury, stroke, Parkinson's disease, schizophrenia, attention deficit hyperactivity disorder, and recent hip fracture. Individuals considered to be frail also benefit from regular physical activity." The key recommendations are provided below.

Key Guidelines for Adults With Chronic Health Conditions and Adults With Disabilities

- Adults with chronic conditions or disabilities, who are able, should do at least 150 minutes a week (2 hours 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour 15 minutes) to 150 minutes (2 hours 30 minutes) a week of vigorous-intensity, aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week
- Adults with chronic conditions or disabilities, who are able, should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits
- When adults with chronic conditions or disabilities are not able to meet the above key guidelines, they should engage in regular physical activity according to their abilities and should avoid inactivity
- Adults with chronic conditions should be under the care of a health care provider. People with chronic conditions can consult a health care professional or physical activity specialist about the types and amounts of activity appropriate for their abilities and chronic conditions

I Zusman et al[281] conducted a systematic review of studies investigating physical activity in older adults after hip fracture and found 2 large[226,252] and 2 small RCTs[132,207] reporting on interventions. All trials demonstrated evidence of increased physical activity as measured by upright time, steps per day, or performing exercises. Interventions included lower extremity strengthening exercise,[132,226,252] motivational training,[207,226] and comprehensive geriatric care.[252] Turunen et al's[265] recent study of a 12-month home-based program (described previously) also found improvement in physical activity level compared to the control group.

AEROBIC EXERCISE ADDED TO STRUCTURED EXERCISE

Evidence

III

Two RCTs[24,189] were included in a systematic review by Handoll et al.[102] These studies investigated multicomponent exercise interventions that included aerobic training but did not specifically investigate the effectiveness of aerobic training. However, they provided evidence regarding safety. Aerobic training appears to be safe and may improve function among those patients who have sustained a hip fracture. Binder et al[24] reported improved lower extremity strength, balance, gait speed, and functional recovery after 6 months of an intensive program that included 5 to 15 minutes of stationary bike or treadmill and progressive resistive training compared to a control group that completed a low-intensity exercise program focused on flexibility. Mangione et al[189] assessed the feasibility of performing aerobic training among older patients with hip fracture. Aerobic training included physical activities, such as walking, stairs, or active-range-of-motion activities, to keep heart rate within 65% to 75% of predicted maximum for 20 minutes. Although underpowered to assess all outcomes, they found greater improvements in lower extremity strength among those who participated in aerobic exercise compared to a no-exercise group. No significant differences were noted in mobility measures or self-reported function.

Characteristics of the aerobic components of the studies are summarized in **TABLE 9**.

MOTIVATIONAL INTERVIEWING FOR PHYSICAL ACTIVITY, MOBILITY, AND SELF-EFFICACY

II

O'Halloran et al[207] investigated the effect of motivational interviewing added to usual care on physical activity, mobility, self-efficacy, and mental health among community-dwelling older adults with recent hip fracture (n = 30). At the completion of the intervention (9 weeks), the motivational interview group had significantly higher physical activity levels as measured by accelerometer, including more steps and minutes walked per day, better mobility, self-efficacy for walking/not falling, and HRQoL. This study was limited by a small sample and lack of longer-term measurement.

MULTIDISCIPLINARY COMPREHENSIVE CARE FOR PHYSICAL ACTIVITY

III

Zusman et al[280] conducted a secondary analysis of physical activity in a small RCT comparing multidisciplinary comprehensive care to usual care among 53 older adults between 3 and 12 months post fracture. Physical activity was assessed at baseline and at 6 and 12 months. They found that for 10 to 13 hours per day the participants were sedentary, and that there were no differences over time. There was no difference between the 2 groups in physical activity. There was a nonsignificant trend toward less physical activity in men than in women. Although this study appears to be underpowered to address the impact of the intervention on physical activity, it provides important information about marked lack of physical activity in older adults after hip fracture that should motivate further investigation.

Evidence Synthesis and Rationale

Based on the current evidence, aerobic exercise such as stationary bike, upper-body ergometer, and long-distance walking can be safely incorporated into a patient's structured exercise program after a hip fracture. Although little evidence is available to compare the specific effects of aerobic exercise to other interventions, such as strengthening and mobility training, many investigations have incorporated aerobic exercises into their protocol and demonstrated the feasibility and safety of aerobic exercise among patients who have had a hip fracture.

Gaps in Knowledge

Although aerobic activities have been incorporated into rehabilitation programs for those with hip fracture, little is known regarding dosage, including intensity and duration. Of the studies highlighted in these guidelines, only 1 study used target heart rate to ensure that aerobic training was achieved.[189] To assess the specific effects of aerobic training, future studies should include dosing parameters, including target heart rate achieved, training duration, and type of activities used.

Recommendations

A

Physical therapists must provide recommendations to patients to maximize safe physical activity.

C

Physical therapists may provide aerobic training in addition to progressive resistive, balance, and mobility training in the community setting for older adults after hip fracture.

A model to guide clinical decisions regarding physical therapy management of older adults with hip fracture is depicted in **FIGURE 2**.

Key Clinical Findings of Hip Pain and Mobility Deficits – Hip Fracture

Measures to assess level of functioning, physical impairments to address with treatment, and response to treatment

Domain	Early Postoperative Period: Inpatient Settings – Must/Should	Early Postoperative Period: Inpatient Settings – May	Postacute Period: Inpatient Settings – Must/Should	Postacute Period: Inpatient Settings – May	Postacute Period: Community Settings – Must/Should	Postacute Period: Community Settings – May
Body functions and structures – physical impairment measures						
Pain	VRS (A)		VRS (A)		VRS (A)	
Lower extremity strength/power	Knee extension (A)		Knee extension (A) Hip muscles (B)		Knee extension (A) Hip muscles (B)	
Activity limitations						
Basic mobility: balance, transfers, ambulation	CAS (A) TUG test (A) NMS: prefracture (B)	AM-PAC basic mobility form (C) SPPB (C)	CAS (A) TUG test (A) NMS (B)	AM-PAC basic mobility form (C) DEMMI (C) SPPB (C)	CAS (A) TUG test (A) NMS (B)	AM-PAC basic mobility form (C) DEMMI (C) SPPB (C)
Gait speed/endurance	Gait speed (A)		Gait speed (A) 6MWT (B)	5-times or 30-s sit-to-stand (B)	Gait speed (A) 6MWT (B)	5-times or 30-s sit-to-stand (B)
Physical function		SF-36 PF-10 (C) FIM (C)		SF-36 PF-10 (C) FIM (C)		SF-36 PF-10 (C)
Fear of falling/self-efficacy	FES-I (B)		FES-I (B)		FES-I (B)	
Health-related quality of life		EQ-5D-3L (C) SF-36 (C)		EQ-5D-3L (C) SF-36 (C)		EQ-5D-3L (C) SF-36 (C)

Interventions tailored to address the specific hip fracture impairments and limitations identified on examination

ACROSS THE ENTIRE EPISODE OF CARE/ALL SETTINGS

Structured Exercise – A
- Progressive, high-intensity resistive strength, balance, weight-bearing, and functional mobility training

Structured Exercise for Older Adults With Cognitive Impairment – B
- For patients with mild to moderate dementia: progressive, high-intensity resistive strength, balance, weight-bearing, and functional mobility training

Interprofessional Management
- Participate in multicomponent, nonpharmacological intervention programs for at-risk older adults undergoing surgery to prevent delirium – C
- Assess hip fracture–related pain at rest and during activity (eg, walking) and implement strategies to minimize the patient's pain during the treatment session to optimize the patient's mobility – F
- Screen for risk of pressure ulcers – F
- Assess and document patient risk factors for falls and contribute to interprofessional management – A
- Contribute to interprofessional care to ensure that older adults with hip fracture are appropriately evaluated and treated for osteoporosis and risk of future fractures – F
- Provide guidance to the interprofessional team and patients on assistive devices and assistance level for transfers and ambulation for patients with hip fracture – F
- Elicit individual goals for recovery of function, which may include independent basic mobility, achieving prior level of function, return to prefracture residence, and activities to support long-term well-being – F

Figure continues on page CPG34.

FIGURE 2. Physical therapy management of older adults with hip fracture: decision-making model. Letters in parentheses reflect the grade of evidence on which the recommendation for each item is based: (A) strong evidence, (B) moderate evidence, (C) weak evidence, (D) conflicting evidence, (E) theoretical/foundational evidence, and (F) expert opinion. Abbreviations: 6MWT, 6-minute walk test; AM-PAC, Activity Measure for Post-Acute Care; CAS, Cumulated Ambulation Score; DEMMI, de Morton Mobility Index; EQ-5D-3L, 3-level version of the EuroQol-5 dimensions scale; FES-I, Falls Efficacy Scale-International; FIM, Functional Independence Measure; NMS, New Mobility Score; PF-10, 10-item physical functioning scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; SPPB, Short Physical Performance Battery; TUG, timed up and go; VRS, verbal rating scale.

EARLY POSTOPERATIVE PERIOD/INPATIENT SETTING

Process of Care
- Document time from surgery to first transfer out of bed and time from surgery to first ambulation – F

Interprofessional Rehabilitation Programs – A
- Multidisciplinary orthogeriatric program, which includes physical therapy and early mobilization

Frequency of Physical Therapy – B
- High-frequency (daily) in-hospital physical therapy following surgery for a hip fracture, with duration as tolerated, including instruction in a home program

Early Assisted Transfers and Ambulation – A
- Provide assisted transfer out of bed as soon as possible after hip surgery and at least daily thereafter, unless contraindicated

Aerobic Exercise Added to Structured Exercise – C
- Upper-body aerobic training in addition to progressive resistive, balance, and mobility training in the early postacute period/inpatient setting for older adults after hip fracture

Electrical Stimulation for Quadriceps Strengthening – C
- Electrical stimulation for quadriceps strengthening if other approaches have not been effective

Electrical Stimulation for Pain Management – C
- Electrical stimulation for pain if it is not sufficiently managed with usual measures

TRANSFER OF CARE

Physical therapists should work collaboratively to contribute to interprofessional assessment to ensure safe transfer from the hospital to the community. The assessment should:
- Identify any ongoing needs of the person and his or her family or caregiver
- Be documented and all needs recorded in the person's transition-of-care plan, with a copy provided to the person with hip fracture

Before **transfer from the hospital to home or to a care setting**, physical therapists discuss and agree on a physical therapy care plan with the person with hip fracture and his or her family or caregiver (as appropriate) and provide this to all relevant health care providers

Before transfer of care from the hospital to home for people with hip fracture:
- Establish that they have a safe and enabling home environment; for example, check that appropriate equipment and adaptations have been provided and that caregivers are supported to facilitate independence
- Undertake or arrange a home visit with patients, unless their abilities and needs can be identified in other ways, for example, by demonstrating independence in all self-care activities, including meal preparation, while in the rehabilitation unit

On **transfer of care from the hospital to the community**, the interprofessional team should provide information to all relevant health care providers and the person with hip fracture. This should include:
- Fracture type and surgical procedure
- A summary of rehabilitation progress and current goals
- Precautions and activity/exercise parameters (eg, weight-bearing status, dislocation/exercise/range-of-motion restrictions, and progression guidance)
- Diagnosis and health status
- Functional abilities (including communication and physical needs)
- Hip fracture–related pain assessment
- Care needs, including washing, dressing, help with going to the toilet, and eating
- Psychological (cognitive and emotional) needs
- Medication needs (including the person's ability to manage prescribed medications and any support needed to do so)
- Social circumstances, including caregivers' needs
- Mental capacity regarding the transfer decision
- Management of risk, including the needs of vulnerable adults
- Plans for follow-up, rehabilitation, and access to health and social care and voluntary sector services

After **transfer of care from the hospital**, people with continued impairments and functional deficits after hip fracture (including people in care homes) should be followed up within 72 hours by a home care physical therapist

POSTACUTE PERIOD/HOME CARE AND COMMUNITY SETTINGS

Extended Exercise – A
- Must provide opportunities for additional therapies if strength, balance, and functional deficits remain beyond 8 to 16 weeks after fracture. Additional therapies may include outpatient services, community exercise programs, or a progressive home exercise program, and should include strengthening, balance, functional, and gait training to address existing impairments and activity limitations

Physical Activity Interventions – A
- Must provide recommendations to patients to maximize safe physical activity

Aerobic Exercise Added to Structured Exercise – C
- May provide aerobic training in addition to progressive resistive, balance, and mobility training in the community setting for older adults after hip fracture

REVISE DIAGNOSIS, CHANGE PLAN OF CARE, OR REFER TO APPROPRIATE CLINICIAN
- When the patient's symptoms do not diminish after targeted interventions within the expected time frame as identified in the tailored treatment plan

FIGURE 2 (continued). Physical therapy management of older adults with hip fracture: decision-making model. Letters in parentheses reflect the grade of evidence on which the recommendation for each item is based: (A) strong evidence, (B) moderate evidence, (C) weak evidence, (D) conflicting evidence, (E) theoretical/foundational evidence, and (F) expert opinion. Abbreviations: 6MWT, 6-minute walk test; AM-PAC, Activity Measure for Post-Acute Care; CAS, Cumulated Ambulation Score; DEMMI, de Morton Mobility Index; EQ-5D-3L, 3-level version of the EuroQol-5 dimensions scale; FES-I, Falls Efficacy Scale-International; FIM, Functional Independence Measure; NMS, New Mobility Score; PF-10, 10-item physical functioning scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; SPPB, Short Physical Performance Battery; TUG, timed up and go; VRS, verbal rating scale.

TABLE 2 Hip Fracture Type, Surgical Treatment, and Related Precautions[36,230]

Fracture Type	Surgical Treatment	Dislocation Precaution or Adverse Outcome
Stable femoral neck, minimally displaced valgus impacted femoral neck	Fixation Fixation with percutaneous cannulated screws	None
Unstable, displaced femoral neck	Unipolar or bipolar hemiarthroplasty with cemented stem, anterior or posterior approach Although evidence is limited, THA is often chosen over hemiarthroplasty for more active or younger patients	Lower dislocation rate in hemiarthroplasty than in THA[116,240,270,277,279] Dislocation precautions (limiting adduction, flexion, internal rotation) may be recommended for the posterior approach Evidence is limited and evolving on precaution use, and recommendations may be dependent on patient and surgical factors[57,256] Usually, no dislocation precautions are used for patients with the anterior approach
Stable intertrochanteric fracture	Cephalomedullary nail or sliding (dynamic) hip screw	None
Unstable intertrochanteric	Cephalomedullary nail	None
Subtrochanteric or reverse obliquity fractures	Long cephalomedullary nail	None

Abbreviation: THA, total hip arthroplasty.

TABLE 3 Summary of the Most Predictive Personal Risk Factors Influencing Functional Outcomes and Mortality in Older Adults With Hip Fracture in Both the Short Term (3-4 Months) and Long Term (1 Year or Greater)[151]

Factor	Outcome
Increasing age	Increased mortality or poorer outcome,[80,82-84,93,138,151,156,158,197] time to discharge,[176] discharge to alternative location,[61] risk of subsequent fall with injury[182]
Age, ≥85 y	Higher mortality Less likely to recover prefracture ambulatory status[22,27,149]
Age, >80 y	Increased mortality up to 5 y[162]
Age, >75 y	Lower odds of walking independently 6 mo post fracture compared with those <75 y[218]
Comorbidities (eg, diabetes, other chronic illnesses)	Decreased functional outcome, increased mortality[22,26,39,56,94,129,136,149,176,215,218,231,239]
Lower prefracture functional mobility (eg, activities of daily living)	Increased complications[197] A lower prefracture motor level attenuated motor gains within 6 mo[21,52] Increased mortality or poorer outcome[12,37,39,52,55,110,149,150,158,159,162,163,197,258]
Confusion, cognitive impairment, dementia	Increased mortality,[26,39,114,214] increased mortality and worse functional outcomes,[218,246] worse functional outcomes[80,209] Better prefracture functional status predicted similar functional outcome for older adults with cognitive impairment as for those without impairment[21,232] Compared to older adults without cognitive impairment, functional outcomes and return to the community were worse for older adults with severe cognitive impairment, but similar for those with mild to moderate impairment[119] 95% of patients with low cognitive function had low physical function after fracture[56]; 90% had low physical function prior to the fracture as well

TABLE 4 Summary of Recommendations and Levels of Evidence for Outcome Measures[a]

	Early Postoperative Period: Inpatient Settings		Postacute Period: Inpatient Settings		Postacute Period: Community Settings	
Domain	**Must/Should**	**May**	**Must/Should**	**May**	**Must/Should**	**May**
Body functions and structures – physical impairment measures						
Pain	VRS (A)		VRS (A)		VRS (A)	
Lower extremity strength/power	Knee extension (A)		Knee extension (A) Hip muscles (B)		Knee extension (A) Hip muscles (B)	
Activity limitations						
Basic mobility: balance, transfers, ambulation	CAS (A) TUG test (A) NMS: prefracture (B)	AM-PAC basic mobility form (C) SPPB (C)	CAS (A) TUG test (A) NMS (B)	AM-PAC basic mobility form (C) DEMMI (C) SPPB (C)	CAS (A) TUG test (A) NMS (B)	AM-PAC basic mobility form (C) DEMMI (C) SPPB (C)
Gait speed/endurance	Gait speed (A)		Gait speed (A) 6MWT (B)	5-times or 30-s sit-to-stand (B)	Gait speed (A) 6MWT (B)	5-times or 30-s sit-to-stand (B)
Physical function		SF-36 PF-10 (C) FIM (C)		SF-36 PF-10 (C) FIM (C)		SF-36 PF-10 (C)
Fear of falling/self-efficacy	FES-I (B)		FES-I (B)		FES-I (B)	
Health-related quality of life		EQ-5D-3L (C) SF-36 (C)		EQ-5D-3L (C) SF-36 (C)		EQ-5D-3L (C) SF-36 (C)

Abbreviations: 6MWT, 6-minute walk test; AM-PAC, Activity Measure for Post-Acute Care; CAS, Cumulated Ambulation Score; DEMMI, de Morton Mobility Index; EQ-5D-3L, 3-level version of the EuroQol-5 dimensions scale; FES-I, Falls Efficacy Scale-International; FIM, Functional Independence Measure; NMS, New Mobility Score; PF-10, 10-item physical functioning scale; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; SPPB, Short Physical Performance Battery; TUG, timed up and go; VRS, verbal rating scale.
[a]*A, strong evidence; B, moderate evidence; C, weak evidence.*

TABLE 5 Summary of Exercise Program Characteristics of Studies Included in the Systematic Review by Auais et al[14] in 2012

	Home Based	**Community Based**
Sessions, n	0-56	16-80
Session frequency	Daily	2-3 times per week
Strength training		
Session duration	30-45 min	45-135 min
Intensity	1 kg to 100% of 1-RM	1 kg to 100% of 1-RM
Sets, n	2-3 for each muscle group	2-3 for each muscle group

Abbreviation: 1-RM, 1-repetition maximum.

TABLE 6 Effects of Balance and Progressive Resistance Training

Study/Outcome	Balance Training[a]	Progressive Resistance Training[a]	Extended Exercise After Discharge[b]
Diong et al[66]			
Mobility[c]	0.32 (0.09, 0.55)	0.67 (0.25, 1.08)	
Lee et al[174]			
Balance	0.57 (0.15, 0.99)		
Lower extremity strength	0.28 (0.12, 0.43)		
Gait	0.19 (0.04, 0.35)		
Physical functioning	0.39 (0.11, 0.68)		
Physical performance measures[d]	0.66 (0.13, 1.19)		
Activities of daily living[e]	0.48 (0.04, 0.93)		
Health-related quality of life[f]	0.60 (0.02, 1.18)		
Lee et al[175]			
Balance		0.55 (0.31, 0.80)	
Lower extremity strength		0.42 (0.10, 0.74)	
Gait		0.50 (0.30, 0.70)	
Physical functioning		0.41 (0.24, 0.58)	
Physical performance measures[d]		0.84 (0.20, 1.48)	
Activities of daily living[e]		0.24 (0.04, 0.44)	
Health-related quality of life[f]		Not reported	
Auais et al[14]			
Balance			0.32 (0.15, 0.49)
Lower extremity strength			0.47 (0.27, 0.66)[g]
Gait			0.42 (0.11, 0.73)[h]
Physical functioning			No difference
Physical performance measures[d]			0.53 (0.27, 0.78)
Activities of daily living[e]			No difference
Health-related quality of life[f]			Not reported

[a]*Values are standardized mean difference (95% confidence interval).*
[b]*Values are effect size (95% confidence interval).*
[c]*Included a wide range of mobility outcomes.*
[d]*The timed up-and-go test, the modified Physical Performance Test, the Physical Performance and Mobility Examination, and the Short Physical Performance Battery.*
[e]*The Barthel index, the Functional Independence Measure, basic and instrumental activities of daily living tests, and Lawton's Instrumental Activities of Daily Living Scale.*
[f]*The Medical Outcomes Study 36-Item Short-Form Health Survey (perceived health and self-reported outdoor mobility) and the EuroQol-5 dimensions scale.*
[g]*Affected leg.*
[h]*Fast gait speed; differences were not found for normal gait speed and for the 6-minute walk test.*

TABLE 7 Effect Sizes for Home-Based Exercise Compared to Usual Care (Wu et al[274])

Outcome	Effect[a]	*P* Value
Mobility	0.56 (0.24, 0.87)	.006[b]
Daily activity	0.72 (0.12, 1.33)	.02[b]
Instrumental activity	0.85 (0.06, 1.64)	.03[b]
Balance	0.89 (0.06, 1.73)	.04[b]
Walking outdoors	1.36 (0.74, 2.49)[c]	.32
Usual gait speed	0.28 (−0.33, 0.90)	.37
Fast gait speed	0.34 (−0.54, 1.22)	.45
Emergency department visits	0.69 (0.11, 4.32)[c]	.69

[a]*Values are standardized mean difference (95% confidence interval) unless otherwise indicated.*
[b]*Statistically significant estimate.*
[c]*Values are risk ratio (95% confidence interval).*

TABLE 8 Comparison of Home-Based and Community-Based Results for Selected Outcomes[a]

	Home Based	Community Based
Knee extension strength: affected side	0.36 (0.12, 0.60)	0.68 (0.30, 1.07)
Balance	0.22 (−0.04, 0.47)[b]	0.41 (0.18, 0.64)
Physical performance tests	0.38 (0.04, 0.72)	0.71 (0.33, 1.08)
Timed up and go	0.37 (0.01, 0.73)	1.07 (0.74, 1.40)
Fast gait speed	0.16 (−0.59, 0.91)[b]	0.49 (0.10, 0.88)

[a]*Values are effect size (95% confidence interval).*
[b]*Results were significant in the overall analyses but did not reach significance in the subgroup analysis.*

TABLE 9 Characteristics of Aerobic Exercise Components

Study	Visits	Exercise Type	Warm-up or Cool-down	Intensity	Monitoring
Binder et al[24]	36 sessions, 45-90 min each (with breaks), depending on the participant's ability and tolerance. Frequency: 3 times per week	Exercised on a stationary bicycle or treadmill	Not reported	5-15 min Resistance was set at the highest comfortable setting that was safe for the participant	Not reported
Mangione et al[189]	20 sessions, 30-40 min each, over 12 wk. The session included multiple exercise components	Walked on level surfaces and on stairs, or, if unable, exercises such as upper and lower extremity active range of motion to keep the heart rate elevated	"2 to 3 minutes of warm-up active range of motion exercise"	"Calculated based on the prediction equation of (maximum heart rate = 220 − age). The value was then multiplied by both 65% and 75% to obtain the target heart rate range for training. The training intensity using the Borg Rating of Perceived Exertion Scale was 'moderate' to 'strong' work as consistent with a rating of 3 to 5 on the 0-to-10 scale"	"Polar heart rate monitor worn during the treatment session or, if the subject had cardiac arrhythmia, by palpation of the radial artery.... If the person took medications that altered heart rate response (eg, beta-blockers), the Borg Rating of Perceived Exertion Scale was used"

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REFERENCES

1. 2018 Physical Activity Guidelines Advisory Committee. 2018 Physical Activity Guidelines Advisory Committee Scientific Report. Washington, DC: US Department of Health and Human Services; 2018.
2. Abou-Setta AM, Beaupre LA, Rashiq S, et al. Comparative effectiveness of pain management interventions for hip fracture: a systematic review. *Ann Intern Med*. 2011;155:234-245. https://doi.org/10.7326/0003-4819-155-4-201108160-00346
3. ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation Version 2.0. Pitlochry, UK: Guidelines International Network; 2009.
4. AGREE Research Trust. Appraisal of Guidelines for Research & Evaluation II Instrument. Hamilton, Canada: AGREE Research Trust; 2013.
5. Al-Ani AN, Samuelsson B, Tidermark J, et al. Early operation on patients with a hip fracture improved the ability to return to independent living. A prospective study of 850 patients. *J Bone Joint Surg Am*. 2008;90:1436-1442. https://doi.org/10.2106/JBJS.G.00890
6. Allegrante JP, Peterson MG, Cornell CN, et al. Methodological challenges of multiple-component intervention: lessons learned from a randomized controlled trial of functional recovery after hip fracture. *HSS J*. 2007;3:63-70. https://doi.org/10.1007/s11420-006-9036-x
7. Allen J, Koziak A, Buddingh S, Liang J, Buckingham J, Beaupre LA. Rehabilitation in patients with dementia following hip fracture: a systematic review. *Physiother Can*. 2012;64:190-201. https://doi.org/10.3138/ptc.2011-06BH
8. Alley DE, Hicks GE, Shardell M, et al. Meaningful improvement in gait speed in hip fracture recovery. *J Am Geriatr Soc*. 2011;59:1650-1657. https://doi.org/10.1111/j.1532-5415.2011.03560.x
9. Al Snih S, Peek KM, Sawyer P, Markides KS, Allman RM, Ottenbacher KJ. Life-space mobility in Mexican Americans aged 75 and older. *J Am Geriatr Soc*. 2012;60:532-537. https://doi.org/10.1111/j.1532-5415.2011.03822.x
10. American Academy of Orthopaedic Surgeons. Management of Hip Fractures in the Elderly: Evidence-Based Clinical Practice Guideline. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2014.
11. Ariza-Vega P, Jiménez-Moleón JJ, Kristensen MT. Non-weight-bearing status compromises the functional level up to 1 yr after hip fracture surgery. *Am J Phys Med Rehabil*. 2014;93:641-648. https://doi.org/10.1097/PHM.0000000000000075
12. Ariza-Vega P, Kristensen MT, Martín-Martín L, Jiménez-Moleón JJ. Predictors of long-term mortality in older people with hip fracture. *Arch Phys Med Rehabil*. 2015;96:1215-1221. https://doi.org/10.1016/j.apmr.2015.01.023
13. Ariza-Vega P, Mora-Traverso M, Ortiz-Piña M, Ashe MC, Kristensen MT. Translation, inter-rater reliability, agreement, and internal consistency of the Spanish version of the Cumulated Ambulation Score in patients after hip fracture. *Disabil Rehabil*. 2020;42:2766-2771. https://doi.org/10.1080/09638288.2019.1577499
14. Auais MA, Eilayyan O, Mayo NE. Extended exercise rehabilitation after hip fracture improves patients' physical function: a systematic review and meta-analysis. *Phys Ther*. 2012;92:1437-1451. https://doi.org/10.2522/ptj.20110274
15. Avin KG, Hanke TA, Kirk-Sanchez N, et al. Management of falls in community-dwelling older adults: clinical guidance statement from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association. *Phys Ther*. 2015;95:815-834. https://doi.org/10.2522/ptj.20140415
16. Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM. Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2010;340:c1718. https://doi.org/10.1136/bmj.c1718
17. Bao Y, Fang J, Peng L, et al. Comparison of preincisional and postincisional parecoxib administration on postoperative pain control and cytokine response after total hip replacement. *J Int Med Res*. 2012;40:1804-1811. https://doi.org/10.1177/030006051204000518
18. Barone A, Giusti A, Pizzonia M, et al. Factors associated with an immediate weight-bearing and early ambulation program for older adults after hip fracture repair. *Arch Phys Med Rehabil*. 2009;90:1495-1498. https://doi.org/10.1016/j.apmr.2009.03.013
19. Barrett-Connor E, Siris ES, Wehren LE, et al. Osteoporosis and fracture risk in women of different ethnic groups. *J Bone Miner Res*. 2005;20:185-194. https://doi.org/10.1359/JBMR.041007
20. Bech RD, Lauritsen J, Ovesen O, Overgaard S. The verbal rating scale is reliable for assessment of postoperative pain in hip fracture patients. *Pain Res Treat*. 2015;2015:676212. https://doi.org/10.1155/2015/676212
21. Beloosesky Y, Grinblat J, Epelboym B, Weiss A, Grosman B, Hendel D. Functional gain of hip fracture patients in different cognitive and functional groups. *Clin Rehabil*. 2002;16:321-328. https://doi.org/10.1191/0269215502cr497oa
22. Bentler SE, Liu L, Obrizan M, et al. The aftermath of hip fracture: discharge placement, functional status change, and mortality. *Am J Epidemiol*. 2009;170:1290-1299. https://doi.org/10.1093/aje/kwp266
23. Bertram M, Norman R, Kemp L, Vos T. Review of the long-term disability associated with hip fractures. *Inj Prev*. 2011;17:365-370. https://doi.org/10.1136/ip.2010.029579
24. Binder EF, Brown M, Sinacore DR, Steger-May K, Yarasheski KE, Schechtman KB. Effects of extended outpatient rehabilitation after hip fracture: a randomized controlled trial. *JAMA*. 2004;292:837-846. https://doi.org/10.1001/jama.292.7.837
25. Bischoff-Ferrari HA, Dawson-Hughes B, Platz A, et al. Effect of high-dosage cholecalciferol and extended physiotherapy on complications after hip fracture: a randomized controlled trial. *Arch Intern Med*. 2010;170:813-820. https://doi.org/10.1001/archinternmed.2010.67
26. Björkelund KB, Hommel A, Thorngren KG, Lundberg D, Larsson S. Factors at admission associated with 4 months outcome in elderly patients with hip fracture. *AANA J*. 2009;77:49-58.
27. Björkman MP, Sorva AJ, Risteli J, Tilvis RS. Low parathyroid hormone levels in bedridden geriatric patients with vitamin D deficiency. *J Am Geriatr Soc*. 2009;57:1045-1050. https://doi.org/10.1111/j.1532-5415.2009.02257.x
28. Black DM, Steinbuch M, Palermo L, et al. An assessment tool for predicting fracture risk in postmenopausal women. *Osteoporos Int*. 2001;12:519-528. https://doi.org/10.1007/s001980170072
29. Bloch ML, Jønsson LR, Kristensen MT. Introducing a third Timed Up & Go test trial improves performances of hospitalized and community-dwelling older individuals. *J Geriatr Phys Ther*. 2017;40:121-126. https://doi.org/10.1519/JPT.0000000000000080
30. Bohannon RW. Measuring knee extensor muscle strength. *Am J Phys Med Rehabil*. 2001;80:13-18. https://doi.org/10.1097/00002060-200101000-00004
31. Bohannon RW. Reference values for the five-repetition sit-to-stand test: a descriptive meta-analysis of data from elders. *Percept Mot Skills*. 2006;103:215-222. https://doi.org/10.2466/pms.103.1.215-222
32. Bot SD, Terwee CB, van der Windt DA, Bouter LM, Dekker J, de Vet HC. Clinimetric evaluation of shoulder disability questionnaires: a systematic review of the literature. *Ann Rheum Dis*. 2004;63:335-341. https://doi.org/10.1136/ard.2003.007724
33. Braid V, Barber M, Mitchell SL, Martin BJ, Granat M, Stott DJ. Randomised controlled trial of electrical stimulation of the quadriceps after proximal femoral fracture. *Aging Clin Exp Res*. 2008;20:62-66. https://doi.org/10.1007/BF03324749
34. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA*. 2009;302:1573-1579. https://doi.org/10.1001/jama.2009.1462
35. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting, and evaluation in health care. *Prev Med*. 2010;51:421-424. https://doi.org/10.1016/j.ypmed.2010.08.005
36. Brox WT, Roberts KC, Taksali S, et al. The American Academy of Orthopaedic Surgeons evidence-based guideline on management of hip fractures in the elderly. *J Bone Joint Surg Am*. 2015;97:1196-1199. https://doi.org/10.2106/JBJS.O.00229
37. Burgos E, Gómez-Arnau JI, Díez R, Muñoz L, Fernández-Guisasola J,

Garcia del Valle S. Predictive value of six risk scores for outcome after surgical repair of hip fracture in elderly patients. *Acta Anaesthesiol Scand*. 2008;52:125-131. https://doi.org/10.1111/j.1399-6576.2007.01473.x

38. Butland RJ, Pang J, Gross ER, Woodcock AA, Geddes DM. Two-, six-, and 12-minute walking tests in respiratory disease. *Br Med J (Clin Res Ed)*. 1982;284:1607-1608. https://doi.org/10.1136/bmj.284.6329.1607
39. Butler M, Forte M, Kane RL, et al. Treatment of common hip fractures. *Evid Rep Technol Assess (Full Rep)*. 2009:1-85.
40. Buurman BM, Hoogerduijn JG, van Gemert EA, de Haan RJ, Schuurmans MJ, de Rooij SE. Clinical characteristics and outcomes of hospitalized older patients with distinct risk profiles for functional decline: a prospective cohort study. *PLoS One*. 2012;7:e29621. https://doi.org/10.1371/journal.pone.0029621
41. Bynum JPW, Bell JE, Cantu RV, et al. Second fractures among older adults in the year following hip, shoulder, or wrist fracture. *Osteoporos Int*. 2016;27:2207-2215. https://doi.org/10.1007/s00198-016-3542-6
42. Cauley JA, Lui LY, Barnes D, et al. Successful skeletal aging: a marker of low fracture risk and longevity. The Study of Osteoporotic Fractures (SOF). *J Bone Miner Res*. 2009;24:134-143. https://doi.org/10.1359/jbmr.080813
43. Centers for Disease Control and Prevention. Important facts about falls. Available at: https://www.cdc.gov/homeandrecreationalsafety/falls/adult-falls.html. Accessed February 6, 2018.
44. Centers for Disease Control and Prevention. WISQARS™—Web-based Injury Statistics Query and Reporting System. Available at: http://www.cdc.gov/injury/wisqars/index.html. Accessed January 1, 2019.
45. Chen X, Yang W, Wang X. Balance training can enhance hip fracture patients' independence in activities of daily living: a meta-analysis of randomized controlled trials. *Medicine (Baltimore)*. 2020;99:e19641. https://doi.org/10.1097/MD.0000000000019641
46. Cheng SY, Levy AR, Lefaivre KA, Guy P, Kuramoto L, Sobolev B. Geographic trends in incidence of hip fractures: a comprehensive literature review. *Osteoporos Int*. 2011;22:2575-2586. https://doi.org/10.1007/s00198-011-1596-z
47. Chu CH, Paquin K, Puts M, Babineau J, van Wyk PM, McGilton KS. Community-based hip fracture rehabilitation interventions for older adults with cognitive impairment: a systematic review. *JMIR Rehabil Assist Technol*. 2016;3:e3. https://doi.org/10.2196/rehab.5102
48. Chudyk AM, Jutai JW, Petrella RJ, Speechley M. Systematic review of hip fracture rehabilitation practices in the elderly. *Arch Phys Med Rehabil*. 2009;90:246-262. https://doi.org/10.1016/j.apmr.2008.06.036
49. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
50. Conley RB, Adib G, Adler RA, et al. Secondary fracture prevention: consensus clinical recommendations from a multistakeholder coalition. *Orthop Nurs*. 2020;39:145-161. https://doi.org/10.1097/NOR.0000000000000672
51. Cooper C, Campion G, Melton LJ, 3rd. Hip fractures in the elderly: a world-wide projection. *Osteoporos Int*. 1992;2:285-289. https://doi.org/10.1007/BF01623184
52. Cornwall R, Gilbert MS, Koval KJ, Strauss E, Siu AL. Functional outcomes and mortality vary among different types of hip fractures: a function of patient characteristics. *Clin Orthop Relat Res*. 2004:64-71. https://doi.org/10.1097/01.blo.0000132406.37763.b3
53. Craik RL. Disability following hip fracture. *Phys Ther*. 1994;74:387-398. https://doi.org/10.1093/ptj/74.5.387
54. Crandall CJ, Yildiz VO, Wactawski-Wende J, et al. Postmenopausal weight change and incidence of fracture: post hoc findings from Women's Health Initiative Observational Study and Clinical Trials. *BMJ*. 2015;350:h25. https://doi.org/10.1136/bmj.h25
55. Cree AK, Nade S. How to predict return to the community after fractured proximal femur in the elderly. *Aust N Z J Surg*. 1999;69:723-725. https://doi.org/10.1046/j.1440-1622.1999.01673.x
56. Cree M, Carriere KC, Soskolne CL, Suarez-Almazor M. Functional dependence after hip fracture. *Am J Phys Med Rehabil*. 2001;80:736-743. https://doi.org/10.1097/00002060-200110000-00006
57. Crompton J, Osagie-Clouard L, Patel A. Do hip precautions after posterior-approach total hip arthroplasty affect dislocation rates? A systematic review of 7 studies with 6,900 patients. *Acta Orthop*. 2020:1-6. https://doi.org/10.1080/17453674.2020.1795598
58. Crotty M, Killington M, Liu E, et al. Should we provide outreach rehabilitation to very old people living in nursing care facilities after a hip fracture? A randomised controlled trial. *Age Ageing*. 2019;48:373-380. https://doi.org/10.1093/ageing/afz005
59. Csuka M, McCarty DJ. Simple method for measurement of lower extremity muscle strength. *Am J Med*. 1985;78:77-81. https://doi.org/10.1016/0002-9343(85)90465-6
60. Cummings SR, Nevitt MC, Study of Osteoporotic Fractures Research Group. Non-skeletal determinants of fractures: the potential importance of the mechanics of falls. *Osteoporos Int*. 1994;4 suppl 1:S67-S70. https://doi.org/10.1007/BF01623439
61. Deakin DE, Wenn RT, Moran CG. Factors influencing discharge location following hip fracture. *Injury*. 2008;39:213-218. https://doi.org/10.1016/j.injury.2007.07.012
62. De Laet C, Kanis JA, Odén A, et al. Body mass index as a predictor of fracture risk: a meta-analysis. *Osteoporos Int*. 2005;16:1330-1338. https://doi.org/10.1007/s00198-005-1863-y
63. de Morton NA, Davidson M, Keating JL. The de Morton Mobility Index (DEMMI): an essential health index for an ageing world. *Health Qual Life Outcomes*. 2008;6:63. https://doi.org/10.1186/1477-7525-6-63
64. de Morton NA, Harding KE, Taylor NF, Harrison G. Validity of the de Morton Mobility Index (DEMMI) for measuring the mobility of patients with hip fracture during rehabilitation. *Disabil Rehabil*. 2013;35:325-333. https://doi.org/10.3109/09638288.2012.705220
65. Dewhirst RC, Ellis DP, Mandara EA, Jette DU. Therapists' perceptions of application and implementation of AM-PAC "6-Clicks" functional measures in acute care: qualitative study. *Phys Ther*. 2016;96:1085-1092. https://doi.org/10.2522/ptj.20150009
66. Diong J, Allen N, Sherrington C. Structured exercise improves mobility after hip fracture: a meta-analysis with meta-regression. *Br J Sports Med*. 2016;50:346-355. https://doi.org/10.1136/bjsports-2014-094465
67. Doll H, Gentile B, Bush EN, Ballinger R. Evaluation of the measurement properties of four performance outcome measures in patients with elective hip replacements, elective knee replacements, or hip fractures. *Value Health*. 2018;21:1104-1114. https://doi.org/10.1016/j.jval.2018.02.006
68. Duppils GS, Wikblad K. Cognitive function and health-related quality of life after delirium in connection with hip surgery: a six-month follow-up. *Orthop Nurs*. 2004;23:195-203. https://doi.org/10.1097/00006416-200405000-00009
69. Duque G, Kiel DP. *Osteoporosis in Older Persons: Pathophysiology and Therapeutic Approach*. London, UK: Springer; 2009.
70. Dyer SM, Crotty M, Fairhall N, et al. A critical review of the long-term disability outcomes following hip fracture. *BMC Geriatr*. 2016;16:158. https://doi.org/10.1186/s12877-016-0332-0
71. Elboim-Gabyzon M, Andrawus Najjar S, Shtarker H. Effects of transcutaneous electrical nerve stimulation (TENS) on acute postoperative pain intensity and mobility after hip fracture: a double-blinded, randomized trial. *Clin Interv Aging*. 2019;14:1841-1850. https://doi.org/10.2147/CIA.S203658
72. El-Khoury F, Cassou B, Charles MA, Dargent-Molina P. The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2013;347:f6234. https://doi.org/10.1136/bmj.f6234
73. Ellis AA, Trent RB. Hospitalized fall injuries and race in California. *Inj Prev*. 2001;7:316-320. https://doi.org/10.1136/ip.7.4.316
74. Endo Y, Aharonoff GB, Zuckerman JD, Egol KA, Koval KJ. Gender differences in patients with hip fracture: a greater risk of morbidity and mortality in men. *J Orthop Trauma*. 2005;19:29-35. https://doi.org/10.1097/00005131-200501000-00006
75. Farag I, Sherrington C, Kamper SJ, et al. Measures of physical functioning after hip fracture: construct validity and responsiveness of performance-based and self-reported measures. *Age Ageing*. 2012;41:659-664.

https://doi.org/10.1093/ageing/afs090
76. Faulkner KG, Cummings SR, Black D, Palermo L, Glüer CC, Genant HK. Simple measurement of femoral geometry predicts hip fracture: the study of osteoporotic fractures. *J Bone Miner Res*. 1993;8:1211-1217. https://doi.org/10.1002/jbmr.5650081008
77. Ferriero G, Kristensen MT, Invernizzi M, et al. Psychometric properties of the Cumulated Ambulation Score: a systematic review. *Eur J Phys Rehabil Med*. 2018;54:766-771. https://doi.org/10.23736/S1973-9087.18.04822-0
78. Feskanich D, Singh V, Willett WC, Colditz GA. Vitamin A intake and hip fractures among postmenopausal women. *JAMA*. 2002;287:47-54. https://doi.org/10.1001/jama.287.1.47
79. Fierens J, Broos PL. Quality of life after hip fracture surgery in the elderly. *Acta Chir Belg*. 2006;106:393-396. https://doi.org/10.1080/00015458.2006.11679913
80. Fisher AA, Srikusalanukul W, Davis MW, Smith PN. Clinical profiles and risk factors for outcomes in older patients with cervical and trochanteric hip fracture: similarities and differences. *J Trauma Manag Outcomes*. 2012;6:2. https://doi.org/10.1186/1752-2897-6-2
81. Fitzgerald M, Blake C, Askin D, Quinlan J, Coughlan T, Cunningham C. Mobility one week after a hip fracture – can it be predicted? *Int J Orthop Trauma Nurs*. 2018;29:3-9. https://doi.org/10.1016/j.ijotn.2017.11.001
82. Foss NB, Kehlet H. Hidden blood loss after surgery for hip fracture. *J Bone Joint Surg Br*. 2006;88:1053-1059. https://doi.org/10.1302/0301-620X.88B8.17534
83. Foss NB, Kehlet H. Short-term mortality in hip fracture patients admitted during weekends and holidays. *Br J Anaesth*. 2006;96:450-454. https://doi.org/10.1093/bja/ael012
84. Foss NB, Kristensen MT, Kehlet H. Anaemia impedes functional mobility after hip fracture surgery. *Age Ageing*. 2008;37:173-178. https://doi.org/10.1093/ageing/afm161
85. Foss NB, Kristensen MT, Kehlet H. Prediction of postoperative morbidity, mortality and rehabilitation in hip fracture patients: the cumulated ambulation score. *Clin Rehabil*. 2006;20:701-708. https://doi.org/10.1191/0269215506cre987oa
86. Fox KM, Cummings SR, Williams E, Stone K, Study of Osteoporotic Fractures. Femoral neck and intertrochanteric fractures have different risk factors: a prospective study. *Osteoporos Int*. 2000;11:1018-1023. https://doi.org/10.1007/s001980070022
87. Freter SH, Fruchter N. Relationship between timed 'up and go' and gait time in an elderly orthopaedic rehabilitation population. *Clin Rehabil*. 2000;14:96-101. https://doi.org/10.1191/026921500675545616
88. Ganz SB, Peterson MG, Russo PW, Guccione A. Functional recovery after hip fracture in the subacute setting. *HSS J*. 2007;3:50-57. https://doi.org/10.1007/s11420-006-9022-3
89. Gherardini S, Biricolti C, Benvenuti E, et al. Prognostic implications of predischarge assessment of gait speed after hip fracture surgery. *J Geriatr Phys Ther*. 2019;42:148-152. https://doi.org/10.1519/JPT.0000000000000144
90. Gorodetskyi IG, Gorodnichenko AI, Tursin PS, Reshetnyak VK, Uskov ON. Non-invasive interactive neurostimulation in the post-operative recovery of patients with a trochanteric fracture of the femur. A randomised, controlled trial. *J Bone Joint Surg Br*. 2007;89:1488-1494. https://doi.org/10.1302/0301-620X.89B11.19352
91. Grana E, Verzellotti S, Grassi FA, et al. Cross-cultural validation of the Italian version of the Cumulated Ambulation Score. *Int J Rehabil Res*. 2016;39:160-164. https://doi.org/10.1097/MRR.0000000000000165
92. Greenspan SL, Myers ER, Kiel DP, Parker RA, Hayes WC, Resnick NM. Fall direction, bone mineral density, and function: risk factors for hip fracture in frail nursing home elderly. *Am J Med*. 1998;104:539-545. https://doi.org/10.1016/s0002-9343(98)00115-6
93. Guccione AA, Fagerson TL, Anderson JJ. Regaining functional independence in the acute care setting following hip fracture. *Phys Ther*. 1996;76:818-826. https://doi.org/10.1093/ptj/76.8.818
94. Guerini F, Morghen S, Lucchi E, Bellelli G, Trabucchi M. Depressive symptoms and one year mortality among elderly patients discharged from a rehabilitation ward after orthopaedic surgery of the lower limbs. *Behav Neurol*. 2010;23:117-121. https://doi.org/10.3233/BEN-2010-0274
95. Guo J, Gao C, Xin H, et al. Correction to: the application of "upper-body yoga" in elderly patients with acute hip fracture: a prospective, randomized, and single-blind study. *J Orthop Surg Res*. 2019;14:340. https://doi.org/10.1186/s13018-019-1369-5
96. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol*. 1994;49:M85-M94. https://doi.org/10.1093/geronj/49.2.m85
97. Haentjens P, Magaziner J, Colón-Emeric CS, et al. Meta-analysis: excess mortality after hip fracture among older women and men. *Ann Intern Med*. 2010;152:380-390. https://doi.org/10.7326/0003-4819-152-6-201003160-00008
98. Häkkinen A, Heinonen M, Kautiainen H, Huusko T, Sulkava R, Karppi P. Effect of cognitive impairment on basic activities of daily living in hip fracture patients: a 1-year follow-up. *Aging Clin Exp Res*. 2007;19:139-144. https://doi.org/10.1007/BF03324680
99. Halbert J, Crotty M, Whitehead C, et al. Multi-disciplinary rehabilitation after hip fracture is associated with improved outcome: a systematic review. *J Rehabil Med*. 2007;39:507-512. https://doi.org/10.2340/16501977-0102
100. Hall SE, Williams JA, Senior JA, Goldswain PR, Criddle RA. Hip fracture outcomes: quality of life and functional status in older adults living in the community. *Aust N Z J Med*. 2000;30:327-332. https://doi.org/10.1111/j.1445-5994.2000.tb00833.x
101. Handoll HH, Sherrington C. Mobilisation strategies after hip fracture surgery in adults. *Cochrane Database Syst Rev*. 2007:CD001704. https://doi.org/10.1002/14651858.CD001704.pub3
102. Handoll HH, Sherrington C, Mak JC. Interventions for improving mobility after hip fracture surgery in adults. *Cochrane Database Syst Rev*. 2011:CD001704. https://doi.org/10.1002/14651858.CD001704.pub4
103. Handoll HH, Sherrington C, Parker MJ. Mobilisation strategies after hip fracture surgery in adults. *Cochrane Database Syst Rev*. 2004:CD001704. https://doi.org/10.1002/14651858.CD001704.pub2
104. Hans D, Durosier C, Kanis JA, Johansson H, Schott-Pethelaz AM, Krieg MA. Assessment of the 10-year probability of osteoporotic hip fracture combining clinical risk factors and heel bone ultrasound: the EPISEM prospective cohort of 12,958 elderly women. *J Bone Miner Res*. 2008;23:1045-1051. https://doi.org/10.1359/jbmr.080229
105. Hayes WC, Myers ER, Morris JN, Gerhart TN, Yett HS, Lipsitz LA. Impact near the hip dominates fracture risk in elderly nursing home residents who fall. *Calcif Tissue Int*. 1993;52:192-198. https://doi.org/10.1007/BF00298717
106. Hayes WC, Myers ER, Robinovitch SN, Van Den Kroonenberg A, Courtney AC, McMahon TA. Etiology and prevention of age-related hip fractures. *Bone*. 1996;18:77S-86S. https://doi.org/10.1016/8756-3282(95)00383-5
107. Haywood KL, Brett J, Tutton E, Staniszewska S. Patient-reported outcome measures in older people with hip fracture: a systematic review of quality and acceptability. *Qual Life Res*. 2017;26:799-812. https://doi.org/10.1007/s11136-016-1424-1
108. Healthcare Cost and Utilization Project. National (Nationwide) Inpatient Sample. Rockville, MD: Agency for Healthcare Research and Quality; 2016.
109. Hedbeck CJ, Blomfeldt R, Lapidus G, Törnkvist H, Ponzer S, Tidermark J. Unipolar hemiarthroplasty versus bipolar hemiarthroplasty in the most elderly patients with displaced femoral neck fractures: a randomised, controlled trial. *Int Orthop*. 2011;35:1703-1711. https://doi.org/10.1007/s00264-011-1213-y
110. Heinonen M, Karppi P, Huusko T, Kautiainen H, Sulkava R. Post-operative degree of mobilization at two weeks predicts one-year mortality after hip fracture. *Aging Clin Exp Res*. 2004;16:476-480. https://doi.org/10.1007/BF03327405
111. Herrick C, Steger-May K, Sinacore DR, Brown M, Schechtman KB, Binder EF. Persistent pain in frail older adults after hip fracture repair. *J Am Geriatr Soc*. 2004;52:2062-2068. https://doi.org/10.1111/j.1532-5415.2004.52566.x

112. Hippisley-Cox J, Coupland C. Derivation and validation of updated QFracture algorithm to predict risk of osteoporotic fracture in primary care in the United Kingdom: prospective open cohort study. *BMJ*. 2012;344:e3427. https://doi.org/10.1136/bmj.e3427

113. Holbrook TL, Barrett-Connor E, Wingard DL. Dietary calcium and risk of hip fracture: 14-year prospective population study. *Lancet*. 1988;2:1046-1049. https://doi.org/10.1016/s0140-6736(88)90065-7

114. Hommel A, Ulander K, Bjorkelund KB, Norrman PO, Wingstrand H, Thorngren KG. Influence of optimised treatment of people with hip fracture on time to operation, length of hospital stay, reoperations and mortality within 1 year. *Injury*. 2008;39:1164-1174. https://doi.org/10.1016/j.injury.2008.01.048

115. Honkavaara N, Al-Ani AN, Campenfeldt P, Ekström W, Hedström M. Good responsiveness with EuroQol 5-Dimension questionnaire and Short Form (36) Health Survey in 20–69 years old patients with a femoral neck fracture: a 2-year prospective follow-up study in 182 patients. *Injury*. 2016;47:1692-1697. https://doi.org/10.1016/j.injury.2016.05.021

116. Hopley C, Stengel D, Ekkernkamp A, Wich M. Primary total hip arthroplasty versus hemiarthroplasty for displaced intracapsular hip fractures in older patients: systematic review. *BMJ*. 2010;340:c2332. https://doi.org/10.1136/bmj.c2332

117. Hulsbaek S, Larsen RF, Rosthøj S, Kristensen MT. The Barthel Index and the Cumulated Ambulation Score are superior to the de Morton Mobility Index for the early assessment of outcome in patients with a hip fracture admitted to an acute geriatric ward. *Disabil Rehabil*. 2019;41:1351-1359. https://doi.org/10.1080/09638288.2018.1424951

118. Hulsbaek S, Larsen RF, Troelsen A. Predictors of not regaining basic mobility after hip fracture surgery. *Disabil Rehabil*. 2015;37:1739-1744. https://doi.org/10.3109/09638288.2014.974836

119. Huusko TM, Karppi P, Avikainen V, Kautiainen H, Sulkava R. Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia. *BMJ*. 2000;321:1107-1111. https://doi.org/10.1136/bmj.321.7269.1107

120. Imam MA, Shehata M, Abdallah AR, et al. Unipolar versus bipolar hemiarthroplasty for displaced femoral neck fractures: a pooled analysis of 30,250 participants data. *Injury*. 2019;50:1694-1708. https://doi.org/10.1016/j.injury.2019.06.004

121. Ingemarsson AH, Frändin K, Hellström K, Rundgren Å. Balance function and fall-related efficacy in patients with newly operated hip fracture. *Clin Rehabil*. 2000;14:497-505. https://doi.org/10.1191/0269215500cr352oa

122. Ingemarsson AH, Frändin K, Mellstrom D, Möller M. Walking ability and activity level after hip fracture in the elderly - a follow-up. *J Rehabil Med*. 2003;35:76-83. https://doi.org/10.1080/16501970306113

123. Jaglal S, Lakhani Z, Schatzker J. Reliability, validity, and responsiveness of the lower extremity measure for patients with a hip fracture. *J Bone Joint Surg Am*. 2000;82-A:955-962. https://doi.org/10.2106/00004623-200007000-00007

124. Jarnlo GB. Hip fracture patients. Background factors and function. *Scand J Rehabil Med Suppl*. 1991;24:1-31.

125. Jellesmark A, Herling SF, Egerod I, Beyer N. Fear of falling and changed functional ability following hip fracture among community-dwelling elderly people: an explanatory sequential mixed method study. *Disabil Rehabil*. 2012;34:2124-2131. https://doi.org/10.3109/09638288.2012.673685

126. Jette DU, Stilphen M, Ranganathan VK, Passek S, Frost FS, Jette AM. Interrater reliability of AM-PAC "6-Clicks" basic mobility and daily activity short forms. *Phys Ther*. 2015;95:758-766. https://doi.org/10.2522/ptj.20140174

127. Jette DU, Stilphen M, Ranganathan VK, Passek SD, Frost FS, Jette AM. AM-PAC "6-Clicks" functional assessment scores predict acute care hospital discharge destination. *Phys Ther*. 2014;94:1252-1261. https://doi.org/10.2522/ptj.20130359

128. Jette DU, Stilphen M, Ranganathan VK, Passek SD, Frost FS, Jette AM. Validity of the AM-PAC "6-Clicks" inpatient daily activity and basic mobility short forms. *Phys Ther*. 2014;94:379-391. https://doi.org/10.2522/ptj.20130199

129. Jiang HX, Majumdar SR, Dick DA, et al. Development and initial validation of a risk score for predicting in-hospital and 1-year mortality in patients with hip fractures. *J Bone Miner Res*. 2005;20:494-500. https://doi.org/10.1359/JBMR.041133

130. Jones CA, Feeny DH. Agreement between patient and proxy responses during recovery after hip fracture: evidence for the FIM instrument. *Arch Phys Med Rehabil*. 2006;87:1382-1387. https://doi.org/10.1016/j.apmr.2006.06.008

131. Jones CA, Jhangri GS, Feeny DH, Beaupre LA. Cognitive status at hospital admission: postoperative trajectory of functional recovery for hip fracture. *J Gerontol A Biol Sci Med Sci*. 2017;72:61-67. https://doi.org/10.1093/gerona/glv138

132. Jones GR, Jakobi JM, Taylor AW, Petrella RJ, Vandervoort AA. Community exercise program for older adults recovering from hip fracture: a pilot study. *J Aging Phys Act*. 2006;14:439-455. https://doi.org/10.1123/japa.14.4.439

133. Jones GR, Miller TA, Petrella RJ. Evaluation of rehabilitation outcomes in older patients with hip fractures. *Am J Phys Med Rehabil*. 2002;81:489-497. https://doi.org/10.1097/00002060-200207000-00004

134. Kammerlander C, Gosch M, Kammerlander-Knauer U, Luger TJ, Blauth M, Roth T. Long-term functional outcome in geriatric hip fracture patients. *Arch Orthop Trauma Surg*. 2011;131:1435-1444. https://doi.org/10.1007/s00402-011-1313-6

135. Kanis JA, Odén A, McCloskey EV, et al. A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporos Int*. 2012;23:2239-2256. https://doi.org/10.1007/s00198-012-1964-3

136. Kannegaard PN, van der Mark S, Eiken P, Abrahamsen B. Excess mortality in men compared with women following a hip fracture. National analysis of comedications, comorbidity and survival. *Age Ageing*. 2010;39:203-209. https://doi.org/10.1093/ageing/afp221

137. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. *Bone*. 1996;18:57S-63S. https://doi.org/10.1016/8756-3282(95)00381-9

138. Karaca S, Ayhan E, Kesmezacar H, Uysal O. Hip fracture mortality: is it affected by anesthesia techniques? *Anesthesiol Res Pract*. 2012;2012:708754. https://doi.org/10.1155/2012/708754

139. Karlsson Å, Berggren M, Gustafson Y, Olofsson B, Lindelöf N, Stenvall M. Effects of geriatric interdisciplinary home rehabilitation on walking ability and length of hospital stay after hip fracture: a randomized controlled trial. *J Am Med Dir Assoc*. 2016;17:464.e9-464.e15. https://doi.org/10.1016/j.jamda.2016.02.001

140. Karlsson Å, Lindelöf N, Olofsson B, et al. Effects of geriatric interdisciplinary home rehabilitation on independence in activities of daily living in older people with hip fracture: a randomized controlled trial. *Arch Phys Med Rehabil*. 2020;101:571-578. https://doi.org/10.1016/j.apmr.2019.12.007

141. Katelaris AG, Cumming RG. Health status before and mortality after hip fracture. *Am J Public Health*. 1996;86:557-560. https://doi.org/10.2105/ajph.86.4.557

142. Katoh M, Kaneko Y. An investigation into reliability of knee extension muscle strength measurements, and into the relationship between muscle strength and means of independent mobility in the ward: examinations of patients who underwent femoral neck fracture surgery. *J Phys Ther Sci*. 2014;26:15-19. https://doi.org/10.1589/jpts.26.15

143. Kempen GI, Yardley L, van Haastregt JC, et al. The Short FES-I: a shortened version of the Falls Efficacy Scale-International to assess fear of falling. *Age Ageing*. 2008;37:45-50. https://doi.org/10.1093/ageing/afm157

144. Kim JW, Byun SE, Chang JS. The clinical outcomes of early internal fixation for undisplaced femoral neck fractures and early full weight-bearing in elderly patients. *Arch Orthop Trauma Surg*. 2014;134:941-946. https://doi.org/10.1007/s00402-014-2003-y

145. Kimmel LA, Liew SM, Sayer JM, Holland AE. HIP4Hips (High Intensity Physiotherapy for Hip fractures in the acute hospital setting): a randomised controlled trial. *Med J Aust*. 2016;205:73-78. https://doi.org/10.5694/mja16.00091

146. Konnopka A, Jerusel N, König HH. The health and economic consequences of osteopenia- and osteoporosis-attributable hip fractures in

Germany: estimation for 2002 and projection until 2050. *Osteoporos Int*. 2009;20:1117-1129. https://doi.org/10.1007/s00198-008-0781-1

147. Koval KJ, Friend KD, Aharonoff GB, Zukerman JD. Weight bearing after hip fracture: a prospective series of 596 geriatric hip fracture patients. *J Orthop Trauma*. 1996;10:526-530. https://doi.org/10.1097/00005131-199611000-00003

148. Koval KJ, Sala DA, Kummer FJ, Zuckerman JD. Postoperative weight-bearing after a fracture of the femoral neck or an intertrochanteric fracture. *J Bone Joint Surg Am*. 1998;80:352-356. https://doi.org/10.2106/00004623-199803000-00007

149. Koval KJ, Skovron ML, Aharonoff GB, Meadows SE, Zuckerman JD. Ambulatory ability after hip fracture: a prospective study in geriatric patients. *Clin Orthop Relat Res*. 1995;310:150-159.

150. Koval KJ, Skovron ML, Aharonoff GB, Zuckerman JD. Predictors of functional recovery after hip fracture in the elderly. *Clin Orthop Relat Res*. 1998;348:22-28.

151. Kristensen MT. Factors affecting functional prognosis of patients with hip fracture. *Eur J Phys Rehabil Med*. 2011;47:257-264.

152. Kristensen MT. Hip fracture–related pain strongly influences functional performance of patients with an intertrochanteric fracture upon discharge from the hospital. *PM R*. 2013;5:135-141. https://doi.org/10.1016/j.pmrj.2012.10.006

153. Kristensen MT, Andersen L, Bech-Jensen R, et al. High intertester reliability of the Cumulated Ambulation Score for the evaluation of basic mobility in patients with hip fracture. *Clin Rehabil*. 2009;23:1116-1123. https://doi.org/10.1177/0269215509342330

154. Kristensen MT, Bandholm T, Bencke J, Ekdahl C, Kehlet H. Knee-extension strength, postural control and function are related to fracture type and thigh edema in patients with hip fracture. *Clin Biomech (Bristol, Avon)*. 2009;24:218-224. https://doi.org/10.1016/j.clinbiomech.2008.10.003

155. Kristensen MT, Bandholm T, Foss NB, Ekdahl C, Kehlet H. High inter-tester reliability of the New Mobility Score in patients with hip fracture. *J Rehabil Med*. 2008;40:589-591. https://doi.org/10.2340/16501977-0217

156. Kristensen MT, Bandholm T, Holm B, Ekdahl C, Kehlet H. Timed Up & Go test score in patients with hip fracture is related to the type of walking aid. *Arch Phys Med Rehabil*. 2009;90:1760-1765. https://doi.org/10.1016/j.apmr.2009.05.013

157. Kristensen MT, Ekdahl C, Kehlet H, Bandholm T. How many trials are needed to achieve performance stability of the Timed Up & Go test in patients with hip fracture? *Arch Phys Med Rehabil*. 2010;91:885-889. https://doi.org/10.1016/j.apmr.2010.01.021

158. Kristensen MT, Foss NB, Ekdahl C, Kehlet H. Prefracture functional level evaluated by the New Mobility Score predicts in-hospital outcome after hip fracture surgery. *Acta Orthop*. 2010;81:296-302. https://doi.org/10.3109/17453674.2010.487240

159. Kristensen MT, Foss NB, Kehlet H. Factors with independent influence on the 'timed up and go' test in patients with hip fracture. *Physiother Res Int*. 2009;14:30-41. https://doi.org/10.1002/pri.414

160. Kristensen MT, Foss NB, Kehlet H. Timed "Up & Go" Test as a predictor of falls within 6 months after hip fracture surgery. *Phys Ther*. 2007;87:24-30. https://doi.org/10.2522/ptj.20050271

161. Kristensen MT, Henriksen S, Stie SB, Bandholm T. Relative and absolute intertester reliability of the Timed Up and Go Test to quantify functional mobility in patients with hip fracture. *J Am Geriatr Soc*. 2011;59:565-567. https://doi.org/10.1111/j.1532-5415.2010.03293.x

162. Kristensen MT, Kehlet H. The basic mobility status upon acute hospital discharge is an independent risk factor for mortality up to 5 years after hip fracture surgery. *Acta Orthop*. 2018;89:47-52. https://doi.org/10.1080/17453674.2017.1382038

163. Kristensen MT, Kehlet H. Most patients regain prefracture basic mobility after hip fracture surgery in a fast-track programme. *Dan Med J*. 2012;59:A4447.

164. Kristensen MT, Öztürk B, Röck ND, Ingeman A, Palm H, Pedersen AB. Regaining pre-fracture basic mobility status after hip fracture and association with post-discharge mortality and readmission—a nationwide register study in Denmark. *Age Ageing*. 2019;48:278-284. https://doi.org/10.1093/ageing/afy185

165. Kronborg L, Bandholm T, Palm H, Kehlet H, Kristensen MT. Effectiveness of acute in-hospital physiotherapy with knee-extension strength training in reducing strength deficits in patients with a hip fracture: a randomised controlled trial. *PLoS One*. 2017;12:e0179867. https://doi.org/10.1371/journal.pone.0179867

166. Kronborg L, Bandholm T, Palm H, Kehlet H, Kristensen MT. Feasibility of progressive strength training implemented in the acute ward after hip fracture surgery. *PLoS One*. 2014;9:e93332. https://doi.org/10.1371/journal.pone.0093332

167. Kuijlaars IAR, Sweerts L, Nijhuis-van der Sanden MWG, et al. Effectiveness of supervised home-based exercise therapy compared to a control intervention on functions, activities, and participation in older patients after hip fracture: a systematic review and meta-analysis. *Arch Phys Med Rehabil*. 2019;100:101-114.e6. https://doi.org/10.1016/j.apmr.2018.05.006

168. Laflamme GY, Rouleau DM, Leduc S, Roy L, Beaumont E. The Timed Up and Go test is an early predictor of functional outcome after hemiarthroplasty for femoral neck fracture. *J Bone Joint Surg Am*. 2012;94:1175-1179. https://doi.org/10.2106/JBJS.J.01952

169. Lafont C, Gérard S, Voisin T, Pahor M, Vellas B, Members of I.A.G.G./A.M.P.A. Task Force. Reducing "iatrogenic disability" in the hospitalized frail elderly. *J Nutr Health Aging*. 2011;15:645-660. https://doi.org/10.1007/s12603-011-0335-7

170. Lamb SE, Oldham JA, Morse RE, Evans JG. Neuromuscular stimulation of the quadriceps muscle after hip fracture: a randomized controlled trial. *Arch Phys Med Rehabil*. 2002;83:1087-1092. https://doi.org/10.1053/apmr.2002.33645

171. Latham NK, Mehta V, Nguyen AM, et al. Performance-based or self-report measures of physical function: which should be used in clinical trials of hip fracture patients? *Arch Phys Med Rehabil*. 2008;89:2146-2155. https://doi.org/10.1016/j.apmr.2008.04.016

172. Lauridsen UB, de la Cour BB, Gottschalck L, Svensson BH. Intensive physical therapy after hip fracture. A randomised clinical trial. *Dan Med Bull*. 2002;49:70-72.

173. LeBoff MS, Kohlmeier L, Hurwitz S, Franklin J, Wright J, Glowacki J. Occult vitamin D deficiency in postmenopausal US women with acute hip fracture. *JAMA*. 1999;281:1505-1511. https://doi.org/10.1001/jama.281.16.1505

174. Lee SY, Jung SH, Lee SU, Ha YC, Lim JY. Effect of balance training after hip fracture surgery: a systematic review and meta-analysis of randomized controlled studies. *J Gerontol A Biol Sci Med Sci*. 2019;74:1679-1685. https://doi.org/10.1093/gerona/gly271

175. Lee SY, Yoon BH, Beom J, Ha YC, Lim JY. Effect of lower-limb progressive resistance exercise after hip fracture surgery: a systematic review and meta-analysis of randomized controlled studies. *J Am Med Dir Assoc*. 2017;18:1096.e19-1096.e26. https://doi.org/10.1016/j.jamda.2017.08.021

176. Lefaivre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuyse HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br*. 2009;91:922-927. https://doi.org/10.1302/0301-620X.91B7.22446

177. Legters K. Fear of falling. *Phys Ther*. 2002;82:264-272. https://doi.org/10.1093/ptj/82.3.264

178. Leino KA, Kuusniemi KS, Lertola KK, Olkkola KT. Comparison of four pain scales in patients with hip fracture or other lower limb trauma. *Acta Anaesthesiol Scand*. 2011;55:495-502. https://doi.org/10.1111/j.1399-6576.2010.02373.x

179. Leslie WD, Lix LM, Manitoba Bone Density Program. Simplified 10-year absolute fracture risk assessment: a comparison of men and women. *J Clin Densitom*. 2010;13:141-146. https://doi.org/10.1016/j.jocd.2010.02.002

180. Lin SN, Su SF, Yeh WT. Meta-analysis: effectiveness of comprehensive geriatric care for elderly following hip fracture surgery. *West J Nurs Res*. 2020;42:293-305. https://doi.org/10.1177/0193945919858715

181. Lin YC, Davey RC, Cochrane T. Tests for physical function of the elderly with knee and hip osteoarthritis. *Scand J Med Sci Sports*. 2001;11:280-286. https://doi.org/10.1034/j.1600-0838.2001.110505.x

182. Lloyd BD, Williamson DA, Singh NA, et al. Recurrent and injurious falls in the year following hip fracture: a prospective study of incidence and risk factors from the Sarcopenia and Hip Fracture study. *J Gerontol A Biol Sci Med Sci*. 2009;64:599-609. https://doi.org/10.1093/gerona/glp003

183. Lockwood KJ, Harding KE, Boyd JN, Taylor NF. Predischarge home visits after hip fracture: a randomized controlled trial. *Clin Rehabil*. 2019;33:681-692. https://doi.org/10.1177/0269215518823256

184. Lusardi MM, Fritz S, Middleton A, et al. Determining risk of falls in community dwelling older adults: a systematic review and meta-analysis using posttest probability. *J Geriatr Phys Ther*. 2017;40:1-36. https://doi.org/10.1519/JPT.0000000000000099

185. MacKinlay K, Falls T, Lau E, et al. Decreasing incidence of femoral neck fractures in the Medicare population. *Orthopedics*. 2014;37:e917-e924. https://doi.org/10.3928/01477447-20140924-60

186. Magaziner J, Fredman L, Hawkes W, et al. Changes in functional status attributable to hip fracture: a comparison of hip fracture patients to community-dwelling aged. *Am J Epidemiol*. 2003;157:1023-1031. https://doi.org/10.1093/aje/kwg081

187. Magaziner J, Mangione KK, Orwig D, et al. Effect of a multicomponent home-based physical therapy intervention on ambulation after hip fracture in older adults: the CAP randomized clinical trial. *JAMA*. 2019;322:946-956. https://doi.org/10.1001/jama.2019.12964

188. Mak JC, Cameron ID, March LM. Evidence-based guidelines for the management of hip fractures in older persons: an update. *Med J Aust*. 2010;192:37-41. https://doi.org/10.5694/j.1326-5377.2010.tb03400.x

189. Mangione KK, Craik RL, Tomlinson SS, Palombaro KM. Can elderly patients who have had a hip fracture perform moderate- to high-intensity exercise at home? *Phys Ther*. 2005;85:727-739. https://doi.org/10.1093/ptj/85.8.727

190. Mendelsohn ME, Leidl DS, Overend TJ, Petrella RJ. Specificity of functional mobility measures in older adults after hip fracture: a pilot study. *Am J Phys Med Rehabil*. 2003;82:766-774. https://doi.org/10.1097/00002060-200310000-00005

191. Mendelsohn ME, Overend TJ, Connelly DM, Petrella RJ. Improvement in aerobic fitness during rehabilitation after hip fracture. *Arch Phys Med Rehabil*. 2008;89:609-617. https://doi.org/10.1016/j.apmr.2007.09.036

192. Milte R, Crotty M, Miller MD, Whitehead C, Ratcliffe J. Quality of life in older adults following a hip fracture: an empirical comparison of the ICECAP-O and the EQ-5D-3 L instruments. *Health Qual Life Outcomes*. 2018;16:173. https://doi.org/10.1186/s12955-018-1005-9

193. Mitchell SL, Stott DJ, Martin BJ, Grant SJ. Randomized controlled trial of quadriceps training after proximal femoral fracture. *Clin Rehabil*. 2001;15:282-290. https://doi.org/10.1191/026921501676849095

194. Moore JL, Potter K, Blankshain K, Kaplan SL, O'Dwyer LC, Sullivan JE. A core set of outcome measures for adults with neurologic conditions undergoing rehabilitation: a clinical practice guideline. *J Neurol Phys Ther*. 2018;42:174-220. https://doi.org/10.1097/NPT.0000000000000229

195. Moseley AM, Sherrington C, Lord SR, Barraclough E, St George RJ, Cameron ID. Mobility training after hip fracture: a randomised controlled trial. *Age Ageing*. 2009;38:74-80. https://doi.org/10.1093/ageing/afn217

196. Munson JC, Bynum JPW, Bell JE, et al. Impact of prescription drugs on second fragility fractures among US Medicare patients. *Osteoporos Int*. 2018;29:2771-2779. https://doi.org/10.1007/s00198-018-4697-0

197. Myers AH, Palmer MH, Engel BT, Warrenfeltz DJ, Parker JA. Mobility in older patients with hip fractures: examining prefracture status, complications, and outcomes at discharge from the acute-care hospital. *J Orthop Trauma*. 1996;10:99-107. https://doi.org/10.1097/00005131-199602000-00005

198. National Institute for Health and Care Excellence. Delirium: Prevention, Diagnosis and Management. London, UK: National Institute for Health and Care Excellence; 2019.

199. National Institute for Health and Care Excellence. Hip Fracture: Management. London, UK: National Institute for Health and Care Excellence; 2017.

200. National Institute for Health and Care Excellence. Osteoporosis: Assessing the Risk of Fragility Fracture. London, UK: National Institute for Health and Care Excellence; 2017.

201. National Institute for Health and Care Excellence. Stroke Rehabilitation in Adults. London, UK: National Institute for Health and Care Excellence; 2013.

202. Nevitt MC, Cummings SR, Kidd S, Black D. Risk factors for recurrent nonsyncopal falls. A prospective study. *JAMA*. 1989;261:2663-2668. https://doi.org/10.1001/jama.1989.03420180087036

203. Nightingale EJ, Sturnieks D, Sherrington C, Moseley AM, Cameron ID, Lord SR. Impaired weight transfer persists at least four months after hip fracture and rehabilitation. *Clin Rehabil*. 2010;24:565-573. https://doi.org/10.1177/0269215509360753

204. Nygard H, Matre K, Fevang JM. Evaluation of Timed Up and Go Test as a tool to measure postoperative function and prediction of one year walking ability for patients with hip fracture. *Clin Rehabil*. 2016;30:472-480. https://doi.org/10.1177/0269215515591039

205. Nymark T, Lauritsen JM, Ovesen O, Röck ND, Jeune B. Short time-frame from first to second hip fracture in the Funen County Hip Fracture Study. *Osteoporos Int*. 2006;17:1353-1357. https://doi.org/10.1007/s00198-006-0125-y

206. Oh MK, Yoo JI, Byun H, et al. Efficacy of combined antigravity treadmill and conventional rehabilitation after hip fracture in patients with sarcopenia. *J Gerontol A Biol Sci Med Sci*. 2020;75:e173-e181. https://doi.org/10.1093/gerona/glaa158

207. O'Halloran PD, Shields N, Blackstock F, Wintle E, Taylor NF. Motivational interviewing increases physical activity and self-efficacy in people living in the community after hip fracture: a randomized controlled trial. *Clin Rehabil*. 2016;30:1108-1119. https://doi.org/10.1177/0269215515617814

208. Oldmeadow LB, Edwards ER, Kimmel LA, Kipen E, Robertson VJ, Bailey MJ. No rest for the wounded: early ambulation after hip surgery accelerates recovery. *ANZ J Surg*. 2006;76:607-611. https://doi.org/10.1111/j.1445-2197.2006.03786.x

209. Oude Voshaar RC, Banerjee S, Horan M, et al. Fear of falling more important than pain and depression for functional recovery after surgery for hip fracture in older people. *Psychol Med*. 2006;36:1635-1645. https://doi.org/10.1017/S0033291706008270

210. Overgaard J, Kristensen MT. Feasibility of progressive strength training shortly after hip fracture surgery. *World J Orthop*. 2013;4:248-258. https://doi.org/10.5312/wjo.v4.i4.248

211. Overgaard JA, Larsen CM, Holtze S, Ockholm K, Kristensen MT. Interrater reliability of the 6-minute walk test in women with hip fracture. *J Geriatr Phys Ther*. 2017;40:158-166. https://doi.org/10.1519/JPT.0000000000000088

212. Palombaro KM, Craik RL, Mangione KK, Tomlinson JD. Determining meaningful changes in gait speed after hip fracture. *Phys Ther*. 2006;86:809-816. https://doi.org/10.1093/ptj/86.6.809

213. Parker MJ, Gillespie WJ, Gillespie LD. Effectiveness of hip protectors for preventing hip fractures in elderly people: systematic review. *BMJ*. 2006;332:571-574. https://doi.org/10.1136/bmj.38753.375324.7C

214. Parker MJ, Palmer CR. A new mobility score for predicting mortality after hip fracture. *J Bone Joint Surg Br*. 1993;75:797-798. https://doi.org/10.1302/0301-620X.75B5.8376443

215. Parker MJ, Palmer CR. Prediction of rehabilitation after hip fracture. *Age Ageing*. 1995;24:96-98. https://doi.org/10.1093/ageing/24.2.96

216. Parsons N, Griffin XL, Achten J, Costa ML. Outcome assessment after hip fracture: is EQ-5D the answer? *Bone Joint Res*. 2014;3:69-75. https://doi.org/10.1302/2046-3758.33.2000250

217. Pedersen TJ, Lauritsen JM. Routine functional assessment for hip fracture patients. *Acta Orthop*. 2016;87:374-379. https://doi.org/10.1080/17453674.2016.1197534

218. Penrod JD, Litke A, Hawkes WG, et al. The association of race, gender, and comorbidity with mortality and function after hip fracture. *J Gerontol A Biol Sci Med Sci*. 2008;63:867-872. https://doi.org/10.1093/gerona/63.8.867

219. Phillips B, Ball C, Sackett D, et al. Oxford Centre for Evidence-based Medicine - Levels of Evidence (March 2009). Available at: http://www.cebm.

net/index.aspx?o=1025. Accessed November 29, 2009.

220. Piscitelli P, Metozzi A, Benvenuti E, et al. Connections between the outcomes of osteoporotic hip fractures and depression, delirium or dementia in elderly patients: rationale and preliminary data from the CODE study. *Clin Cases Miner Bone Metab*. 2012;9:40-44.

221. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*. 1991;39:142-148. https://doi.org/10.1111/j.1532-5415.1991.tb01616.x

222. Rabar S, Lau R, O'Flynn N, Li L, Barry P, Guideline Development Group. Risk assessment of fragility fractures: summary of NICE guidance. *BMJ*. 2012;345:e3698. https://doi.org/10.1136/bmj.e3698

223. Randell AG, Nguyen TV, Bhalerao N, Silverman SL, Sambrook PN, Eisman JA. Deterioration in quality of life following hip fracture: a prospective study. *Osteoporos Int*. 2000;11:460-466. https://doi.org/10.1007/s001980070115

224. Ratcliffe J, Flint T, Easton T, et al. An empirical comparison of the EQ-5D-5L, DEMQOL-U and DEMQOL-Proxy-U in a post-hospitalisation population of frail older people living in residential aged care. *Appl Health Econ Health Policy*. 2017;15:399-412. https://doi.org/10.1007/s40258-016-0293-7

225. Renerts K, Fischer K, Dawson-Hughes B, et al. Effects of a simple home exercise program and vitamin D supplementation on health-related quality of life after a hip fracture: a randomized controlled trial. *Qual Life Res*. 2019;28:1377-1386. https://doi.org/10.1007/s11136-019-02100-4

226. Resnick B, Orwig D, Yu-Yahiro J, et al. Testing the effectiveness of the exercise plus program in older women post-hip fracture. *Ann Behav Med*. 2007;34:67-76. https://doi.org/10.1007/BF02879922

227. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Act*. 1999;7:129-161. https://doi.org/10.1123/japa.7.2.129

228. Rikli RE, Jones CJ. Functional fitness normative scores for community-residing older adults, ages 60-94. *J Aging Phys Act*. 1998;7:162-181. https://doi.org/10.1123/japa.7.2.162

229. Robbins JA, Aragaki A, Crandall CJ, et al. Women's Health Initiative clinical trials: interaction of calcium and vitamin D with hormone therapy. *Menopause*. 2014;21:116-123. https://doi.org/10.1097/GME.0b013e3182963901

230. Roberts KC, Brox WT. AAOS clinical practice guideline: management of hip fractures in the elderly. *J Am Acad Orthop Surg*. 2015;23:138-140. https://doi.org/10.5435/JAAOS-D-14-00433

231. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *BMJ*. 2005;331:1374. https://doi.org/10.1136/bmj.38643.663843.55

232. Rolland Y, Pillard F, Lauwers-Cances V, Busquère F, Vellas B, Lafont C. Rehabilitation outcome of elderly patients with hip fracture and cognitive impairment. *Disabil Rehabil*. 2004;26:425-431. https://doi.org/10.1080/09638280410001663148

233. Samelson EJ, Zhang Y, Kiel DP, Hannan MT, Felson DT. Effect of birth cohort on risk of hip fracture: age-specific incidence rates in the Framingham Study. *Am J Public Health*. 2002;92:858-862. https://doi.org/10.2105/ajph.92.5.858

234. Sandhu SK, Nguyen ND, Center JR, Pocock NA, Eisman JA, Nguyen TV. Prognosis of fracture: evaluation of predictive accuracy of the FRAX™ algorithm and Garvan nomogram. *Osteoporos Int*. 2010;21:863-871. https://doi.org/10.1007/s00198-009-1026-7

235. Scheffer AC, Schuurmans MJ, van Dijk N, van der Hooft T, de Rooij SE. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. *Age Ageing*. 2008;37:19-24. https://doi.org/10.1093/ageing/afm169

236. Scheffers-Barnhoorn MN, van Eijk M, van Haastregt JCM, et al. Effects of the FIT-HIP intervention for fear of falling after hip fracture: a cluster-randomized controlled trial in geriatric rehabilitation. *J Am Med Dir Assoc*. 2019;20:857-865.e2. https://doi.org/10.1016/j.jamda.2019.03.009

237. Schwenk M, Schmidt M, Pfisterer M, Oster P, Hauer K. Rollator use adversely impacts on assessment of gait and mobility during geriatric rehabilitation. *J Rehabil Med*. 2011;43:424-429. https://doi.org/10.2340/16501977-0791

238. Scottish Intercollegiate Guidelines Network. Management of Hip Fracture in Older People: A National Clinical Guideline. Edinburgh, UK: Scottish Intercollegiate Guidelines Network; 2009.

239. Semel J, Gray JM, Ahn HJ, Nasr H, Chen JJ. Predictors of outcome following hip fracture rehabilitation. *PM R*. 2010;2:799-805. https://doi.org/10.1016/j.pmrj.2010.04.019

240. Sharma V, Awasthi B, Kumar K, Kohli N, Katoch P. Outcome analysis of hemiarthroplasty vs. total hip replacement in displaced femoral neck fractures in the elderly. *J Clin Diagn Res*. 2016;10:RC11-RC13. https://doi.org/10.7860/JCDR/2016/18638.7877

241. Sherrington C, Lord SR. Reliability of simple portable tests of physical performance in older people after hip fracture. *Clin Rehabil*. 2005;19:496-504. https://doi.org/10.1191/0269215505cr833oa

242. Sherrington C, Lord SR, Herbert RD. A randomised trial of weight-bearing versus non-weight-bearing exercise for improving physical ability in inpatients after hip fracture. *Aust J Physiother*. 2003;49:15-22. https://doi.org/10.1016/s0004-9514(14)60184-7

243. Shyu YI, Lu JF, Liang J. Evaluation of Medical Outcomes Study Short Form-36 Taiwan version in assessing elderly patients with hip fracture. *Osteoporos Int*. 2004;15:575-582. https://doi.org/10.1007/s00198-003-1580-3

244. Smith TO, Gilbert AW, Sreekanta A, et al. Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery. *Cochrane Database Syst Rev*. 2020;2:CD010569. https://doi.org/10.1002/14651858.CD010569.pub3

245. Smith TO, Hameed YA, Cross JL, Henderson C, Sahota O, Fox C. Enhanced rehabilitation and care models for adults with dementia following hip fracture surgery. *Cochrane Database Syst Rev*. 2015:CD010569. https://doi.org/10.1002/14651858.CD010569.pub2

246. Söderqvist A, Strömberg L, Ponzer S, Tidermark J. Documenting the cognitive status of hip fracture patients using the Short Portable Mental Status Questionnaire. *J Clin Nurs*. 2006;15:308-314. https://doi.org/10.1111/j.1365-2702.2006.01296.x

247. Stasi S, Papathanasiou G, Chronopoulos E, Dontas IA, Baltopoulos IP, Papaioannou NA. The effect of intensive abductor strengthening on postoperative muscle efficiency and functional ability of hip-fractured patients: a randomized controlled trial. *Indian J Orthop*. 2019;53:407-419.

248. Stemmle J, Marzel A, Chocano-Bedoya PO, et al. Effect of 800 IU versus 2000 IU vitamin D3 with or without a simple home exercise program on functional recovery after hip fracture: a randomized controlled trial. *J Am Med Dir Assoc*. 2019;20:530-536.e1. https://doi.org/10.1016/j.jamda.2018.10.013

249. Stenvall M, Berggren M, Lundström M, Gustafson Y, Olofsson B. A multidisciplinary intervention program improved the outcome after hip fracture for people with dementia—subgroup analyses of a randomized controlled trial. *Arch Gerontol Geriatr*. 2012;54:e284-e289. https://doi.org/10.1016/j.archger.2011.08.013

250. Stevens JA, Rudd RA. The impact of decreasing U.S. hip fracture rates on future hip fracture estimates. *Osteoporos Int*. 2013;24:2725-2728. https://doi.org/10.1007/s00198-013-2375-9

251. Sylliaas H, Brovold T, Wyller TB, Bergland A. Prolonged strength training in older patients after hip fracture: a randomised controlled trial. *Age Ageing*. 2012;41:206-212. https://doi.org/10.1093/ageing/afr164

252. Taraldsen K, Sletvold O, Thingstad P, et al. Physical behavior and function early after hip fracture surgery in patients receiving comprehensive geriatric care or orthopedic care—a randomized controlled trial. *J Gerontol A Biol Sci Med Sci*. 2014;69:338-345. https://doi.org/10.1093/gerona/glt097

253. Taraldsen K, Thingstad P, Døhl Ø, et al. Short and long-term clinical effectiveness and cost-effectiveness of a late-phase community-based balance and gait exercise program following hip fracture. The EVA-Hip Randomised Controlled Trial. *PLoS One*. 2019;14:e0224971. https://doi.org/10.1371/journal.pone.0224971

254. Taraldsen K, Thingstad P, Sletvold O, et al. The long-term effect of being treated in a geriatric ward compared to an orthopaedic ward on six mea-

sures of free-living physical behavior 4 and 12 months after a hip fracture - a randomised controlled trial. *BMC Geriatr*. 2015;15:160. https://doi.org/10.1186/s12877-015-0153-6
255. Taylor BC, Schreiner PJ, Stone KL, et al. Long-term prediction of incident hip fracture risk in elderly white women: study of osteoporotic fractures. *J Am Geriatr Soc*. 2004;52:1479-1486. https://doi.org/10.1111/j.1532-5415.2004.52410.x
256. Tetreault MW, Akram F, Li J, et al. Are postoperative hip precautions necessary after primary total hip arthroplasty using a posterior approach? Preliminary results of a prospective randomized trial. *J Arthroplasty*. 2020;35:S246-S251. https://doi.org/10.1016/j.arth.2020.02.019
257. Thingstad P, Taraldsen K, Saltvedt I, et al. The long-term effect of comprehensive geriatric care on gait after hip fracture: the Trondheim Hip Fracture Trial—a randomised controlled trial. *Osteoporos Int*. 2016;27:933-942. https://doi.org/10.1007/s00198-015-3313-9
258. Thorngren KG, Norrman PO, Hommel A, Cedervall M, Thorngren J, Wingstrand H. Influence of age, sex, fracture type and pre-fracture living on rehabilitation pattern after hip fracture in the elderly. *Disabil Rehabil*. 2005;27:1091-1097. https://doi.org/10.1080/09638280500056402
259. Tidermark J, Bergström G, Svensson O, Törnkvist H, Ponzer S. Responsiveness of the EuroQol (EQ 5-D) and the SF-36 in elderly patients with displaced femoral neck fractures. *Qual Life Res*. 2003;12:1069-1079. https://doi.org/10.1023/a:1026193812514
260. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. *J Gerontol*. 1990;45:P239-P243. https://doi.org/10.1093/geronj/45.6.p239
261. Toscan J, Mairs K, Hinton S, Stolee P. Integrated transitional care: patient, informal caregiver and health care provider perspectives on care transitions for older persons with hip fracture. *Int J Integr Care*. 2012;12:e13. https://doi.org/10.5334/ijic.797
262. Tosteson AN, Gottlieb DJ, Radley DC, Fisher ES, Melton LJ, 3rd. Excess mortality following hip fracture: the role of underlying health status. *Osteoporos Int*. 2007;18:1463-1472. https://doi.org/10.1007/s00198-007-0429-6
263. Toussant EM, Kohia M. A critical review of literature regarding the effectiveness of physical therapy management of hip fracture in elderly persons. *J Gerontol A Biol Sci Med Sci*. 2005;60:1285-1291. https://doi.org/10.1093/gerona/60.10.1285
264. Toyama S, Sawada K, Ueshima K, et al. Changes in basic movement ability and activities of daily living after hip fractures: correlation between basic movement scale and motor-functional independence measure scores. *Am J Phys Med Rehabil*. 2018;97:316-322. https://doi.org/10.1097/PHM.0000000000000829
265. Turunen K, Salpakoski A, Edgren J, et al. Physical activity after a hip fracture: effect of a multicomponent home-based rehabilitation program—a secondary analysis of a randomized controlled trial. *Arch Phys Med Rehabil*. 2017;98:981-988. https://doi.org/10.1016/j.apmr.2017.01.004
266. US Department of Health and Human Services. Physical Activity Guidelines for Americans. 2nd ed. Washington, DC: US Department of Health and Human Services; 2018.
267. Uusi-Rasi K, Patil R, Karinkanta S, et al. Exercise and vitamin D in fall prevention among older women: a randomized clinical trial. *JAMA Intern Med*. 2015;175:703-711. https://doi.org/10.1001/jamainternmed.2015.0225
268. van Ooijen MW, Roerdink M, Trekop M, Janssen TW, Beek PJ. The efficacy of treadmill training with and without projected visual context for improving walking ability and reducing fall incidence and fear of falling in older adults with fall-related hip fracture: a randomized controlled trial. *BMC Geriatr*. 2016;16:215. https://doi.org/10.1186/s12877-016-0388-x
269. Visschedijk JH, Terwee CB, Caljouw MA, Spruit-van Eijk M, van Balen R, Achterberg WP. Reliability and validity of the Falls Efficacy Scale-International after hip fracture in patients aged ≥65 years. *Disabil Rehabil*. 2015;37:2225-2232. https://doi.org/10.3109/09638288.2014.1002573
270. Wang Z, Bhattacharyya T. Outcomes of hemiarthroplasty and total hip arthroplasty for femoral neck fracture: a Medicare cohort study. *J Orthop Trauma*. 2017;31:260-263. https://doi.org/10.1097/BOT.0000000000000814
271. Williams NH, Roberts JL, Din NU, et al. Developing a multidisciplinary rehabilitation package following hip fracture and testing in a randomised feasibility study: Fracture in the Elderly Multidisciplinary Rehabilitation (FEMuR). *Health Technol Assess*. 2017;21:1-528. https://doi.org/10.3310/hta21440
272. World Health Organization. Framework for Action on Interprofessional Education & Collaborative Practice. Geneva, Switzerland: World Health Organization; 2010.
273. World Health Organization. *International Classification of Functioning, Disability and Health: ICF*. Geneva, Switzerland: World Health Organization; 2001.
274. Wu D, Zhu X, Zhang S. Effect of home-based rehabilitation for hip fracture: a meta-analysis of randomized controlled trials. *J Rehabil Med*. 2018;50:481-486. https://doi.org/10.2340/16501977-2328
275. Wu JQ, Mao LB, Wu J. Efficacy of balance training for hip fracture patients: a meta-analysis of randomized controlled trials. *J Orthop Surg Res*. 2019;14:83. https://doi.org/10.1186/s13018-019-1125-x
276. Young Y, Fan MY, Hebel JR, Boult C. Concurrent validity of administering the Functional Independence Measure (FIM) instrument by interview. *Am J Phys Med Rehabil*. 2009;88:766-770. https://doi.org/10.1097/PHM.0b013e3181a9f1d6
277. Yu L, Wang Y, Chen J. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures: meta-analysis of randomized trials. *Clin Orthop Relat Res*. 2012;470:2235-2243. https://doi.org/10.1007/s11999-012-2293-8
278. Zingmond DS, Melton LJ, 3rd, Silverman SL. Increasing hip fracture incidence in California Hispanics, 1983 to 2000. *Osteoporos Int*. 2004;15:603-610. https://doi.org/10.1007/s00198-004-1592-7
279. Zi-Sheng A, You-Shui G, Zhi-Zhen J, Ting Y, Chang-Qing Z. Hemiarthroplasty vs primary total hip arthroplasty for displaced fractures of the femoral neck in the elderly: a meta-analysis. *J Arthroplasty*. 2012;27:583-590. https://doi.org/10.1016/j.arth.2011.07.009
280. Zusman EZ, Dawes M, Fleig L, et al. Older adults' sedentary behavior and physical activity after hip fracture: results from an outpatient rehabilitation randomized controlled trial. *J Geriatr Phys Ther*. 2019;42:E32-E38. https://doi.org/10.1519/JPT.0000000000000193
281. Zusman EZ, Dawes MG, Edwards N, Ashe MC. A systematic review of evidence for older adults' sedentary behavior and physical activity after hip fracture. *Clin Rehabil*. 2018;32:679-691. https://doi.org/10.1177/0269215517741665

APPENDIX A

SEARCH STRATEGIES FOR ALL DATABASES SEARCHED

Interventions

PubMed

(((((“patient care team”[mesh:noexp] OR Rehabilitation[mesh] OR rehabilitation[sh] OR “Physical Therapy Modalities”[mesh:noexp] OR “physical therapists”[mesh] OR “physical therapy specialty”[mesh] OR “Musculoskeletal Manipulations”[Mesh] OR hydrotherapy[mesh] OR “exercise movement techniques”[mesh] OR “Exercise Therapy”[Mesh] OR Exercise[mesh] OR “Self-Help Devices”[Mesh] OR “Patient Education as Topic”[Mesh] OR crutches[Mesh] OR Canes[Mesh] OR Walkers[Mesh] OR “orthotic devices”[mesh] OR “Dependent Ambulation”[Mesh] OR mobilization[tiab] OR mobilisation[tiab] OR rehab*[tiab] OR “manual therapy”[tiab] OR “physical therapy”[tiab] OR “physical therapies”[tiab] OR physiotherap*[tiab] OR “physical therapist”[tiab] OR “physical therapists”[tiab] OR multidisciplinary[-tiab] OR interdisciplinary[tiab] OR interprofessional[tiab] OR team*[tiab] OR exercis*[tiab] OR massag*[tiab] OR acupressure[tiab] OR “applied kinesiology”[tiab] OR stretching[tiab] OR stretch[tiab] OR stretches[tiab] OR plyometric[tiab] OR plyometrics[tiab] OR “resistance training”[tiab] OR “strength training”[tiab] OR strengthening[tiab] OR “weight-lifting”[tiab] OR weightlifting[tiab] OR “physical conditioning”[tiab] OR “patient education”[tiab] OR hydrotherapy[tiab] OR “aquatic therapy”[tiab] OR “pool therapy”[tiab] OR “water aerobics”[tiab] OR “water running”[tiab] OR “water training”[tiab] OR “assistive devices”[tiab] OR “assistive device”[tiab] OR “ambulation aid”[tiab] OR “ambulation aids”[tiab] OR “gait aids”[tiab] OR “gait aid”[tiab] OR “gait training”[tiab] OR crutches[tiab] OR walker[tiab] OR walkers[tiab] OR cane[tiab] OR canes[tiab] OR orthotic*[tiab] OR orthoses[tiab] OR orthosis[tiab] OR wheelchair*[-tiab] OR “activity modification”[tiab] OR “functional training”[tiab] OR “flexibility training”[tiab] OR “endurance training”[tiab] OR “proprioceptive neuromuscular facilitation”[tiab] OR “manual resistance”[tiab] OR “aerobic activity”[tiab] OR balanc*[tiab]) AND ((“Hip Fractures”[Mesh] OR “femoral fractures”[mesh]) OR ((hip[mesh] OR “hip joint”[mesh] OR femur[mesh] OR hip[tiab] OR hips[tiab] OR femor*[tiab] OR femur*[tiab] OR femour*[tiab] OR trochanter*[tiab] OR intertrochanter*[tiab] OR intertrochanteric[tiab] OR subtrochanter*[tiab] ORsubtrochanteric[tiab]) AND (“fractures, bone”[mesh:noexp] OR fracture*[tiab])))) NOT (“Case Reports”[Publication Type] OR “Letter”[Publication Type] OR “Comment”[Publication Type] OR “Editorial”[Publication Type]) AND (“last 10 years”[PDat] AND English[lang])) AND “2014/12/19 15.00”[MHDA]:”2018/09/24 15.00”[MHDA]))

CINAHL

	Search Term
S5	S3 NOT PT (“case study” OR letter OR editorial)
S4	S3 NOT PT (“case study” OR letter OR editorial)
S3	S1 AND S2
S2	MH “Hip Fractures+” OR MH “Femoral Fractures+” OR (MH “Hip” OR MH “Hip Joint” OR MH “Femur” OR hip OR hips OR femor* OR femur* OR femour* OR trochanter* OR intertrochanter* OR intertrochanteric OR subtrochanter* OR subtrochanteric) AND (MH “Fractures” OR fracture*)
S1	((MH “Rehabilitation”) OR (MH “Activities of Daily Living”) OR (MH “Home Rehabilitation+”) OR (MH “Physical Therapy”) OR (MH “Occupational Therapy+”) OR (MH “Functional Training”) OR (MH “Gait Training”) OR (MH “Joint Mobilization”) OR (MH “Manual Therapy+”) OR (MH “Pediatric Physical Therapy”) OR (MH “Therapeutic Exercise+”) OR (MH “Rehabilitation, Athletic”) OR (MH “Rehabilitation, Community-Based”) OR (MH “Rehabilitation, Geriatric”) OR (MH “Multidisciplinary Care Team+”) OR (MH “Exercise+”) OR (MH “Assistive Technology Devices+”) OR (MH “Orthoses+”) OR (MH “Patient Education+”) OR (MH “Hydrotherapy+”) OR (MH “Physical Therapists”) OR (MH “Physical Therapist Assistants”) OR (MH “Early Ambulation”) OR (MW “RH”)) OR TI (mobilization OR mobilisation OR rehab* OR “manual therapy” OR “physical therapy” OR “physical therapies” OR physiotherap* OR “physical therapist” OR “physical therapists” OR multidisciplinary OR interdisciplinary OR interprofessional OR team* OR exercis* OR massag* OR acupressure OR “applied kinesiology” OR stretching OR stretch OR stretches OR plyometric* OR “resistance training” OR “strength training” OR strengthening OR “weight-lifting” OR weightlifting OR “physical conditioning” OR “patient education” OR hydrotherapy OR “aquatic therapy” OR “pool therapy” OR “water aerobics” OR “water running” OR “water training” OR “assistive devices” OR “assistive device” OR “ambulation aid” OR “ambulation aids” OR “gait aids” OR “gait aid” OR “gait training” OR crutches OR walker OR walkers OR cane OR canes OR orthotic* OR orthoses OR orthosis OR wheelchair* OR “activity modification” OR “functional training” OR “flexibility training” OR “endurance training” OR “proprioceptive neuromuscular facilitation” OR “manual resistance” OR “aerobic activity” OR balanc*) OR AB (mobilization OR mobilisation OR rehab* OR “manual therapy” OR “physical therapy” OR “physical therapies” OR physiotherap* OR “physical therapist” OR “physical therapists” OR multidisciplinary OR interdisciplinary OR interprofessional OR team* OR exercis* OR massag* OR acupressure OR “applied kinesiology” OR stretching OR stretch OR stretches OR plyometric* OR “resistance training” OR “strength training” OR strengthening OR “weight-lifting” OR weightlifting OR “physical conditioning” OR “patient education” OR hydrotherapy OR “aquatic therapy” OR “pool therapy” OR “water aerobics” OR “water running” OR “water training” OR “assistive devices” OR “assistive device” OR “ambulation aid” OR “ambulation aids” OR “gait aids” OR “gait aid” OR “gait training” OR crutches OR walker OR walkers OR cane OR canes OR orthotic* OR orthoses OR orthosis OR wheelchair* OR “activity modification” OR “functional training” OR “flexibility training” OR “endurance training” OR “proprioceptive neuromuscular facilitation” OR “manual resistance” OR “aerobic activity” OR balanc*)

APPENDIX A

PEDro

Abstract & Title: Fracture*
body part: thigh or hip

Cochrane Library

	Search Term	Results, n
#1	mobilization or mobilisation or rehab* or "manual therapy" or "physical therapy" or "physical therapies" or physiotherap* or "physical therapist" or "physical therapists" or multidisciplinary or interdisciplinary or interprofessional or team* or exercis* or massag* or acupressure or "applied kinesiology" or stretching or stretch or stretches or plyometric* or "resistance training" or "strength training" or strengthening or "weight-lifting" or weightlifting or "physical conditioning" or "patient education" or hydrotherapy or "aquatic therapy" or "pool therapy" or "water aerobics" or "water running" or "water training" or "assistive devices" or "assistive device" or "ambulation aid" or "ambulation aids" or "gait aids" or "gait aid" or "gait training" or crutches or walker or walkers or cane or canes or orthotic* or orthoses or orthosis or wheelchair* or "activity modification" or "functional training" or "flexibility training" or "endurance training" or "proprioceptive neuromuscular facilitation" or "manual resistance" or "aerobic activity" or balanc*:ti,ab,kw	179509
#2	(hip or hips or femor* or femur* or femour* or trochanter* or intertrochanter* or intertrochanteric or subtrochanter* or subtrochanteric) and fracture*:ti,ab,kw	5854
#3	#1 AND #2 with Cochrane Library publication date	

APPENDIX B

SEARCH RESULTS

2005 to 2014[a]

Database/Platform	Years Covered	Results, n
MEDLINE PubMed	2005-2014	2413
CINAHL EBSCO	2005-2014	1063
Cochrane Library Wiley	2005-2014	368
DSR (issue 12, December)		14
DARE (issue 4, October)		11
Trials (issue 11, November)		331
Methods (issue 3, July)		1
Technology assessments (issue 4, October)		6
Economic evaluations (issue 4, October)		5
PEDro http://www.pedro.org.au/	2005-2014	119
Total		3963
Total with duplicates removed		2888

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; DARE, Database of Abstracts of Reviews of Effects; DSR, Database of Systematic Reviews; PEDro, Physiotherapy Evidence Database.
[a]*All searches were conducted on December 19, 2014.*

December 2014 to July 2016[a]

Database/Platform	Years Covered	Results, n
MEDLINE PubMed	December 19, 2014-date	657
CINAHL EBSCO	December 2014-date	129
Cochrane Library Wiley	2014-date	124
DSR (issue 7, July 2016)		8
Trials (issue 6, June 2016)		115
Technology assessments (issue 2, April 2016)		1
Revised total[b]		77
PEDro http://www.pedro.org.au/	2014-date	16
Total		879
Total with duplicates removed		754

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; DSR, Database of Systematic Reviews; PEDro, Physiotherapy Evidence Database.
[a]*All searches were conducted on July 8, 2016.*
[b]*Cochrane search results include all of 2014 (overlapping original search). We removed records already found in the original search (based on Cochrane English-language original search results): 47 previously found results were removed, leaving 77 new results.*

September 2018

	Initial Results, n	After Duplicates Removed, n	After Duplicates Removed From Prior Search Results, n[a]
PubMed	1544	1541	930
Cochrane Library[b]	0	0	0
CINAHL	415	140	105
PEDro	34	10	3
Total	1993	1691	1038

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; PEDro, Physiotherapy Evidence Database.
[a]*From December 2014 to July 2016.*
[b]*There was a technical problem with the Cochrane export function; the search was run in January 2019, with the following results: initial results, n = 341; after duplicates removed, n = 198; after duplicates removed from prior search results, n = 198.*

APPENDIX B

April 9, 2019

	Results, n
PubMed	279
Cochrane Library	4
CINAHL	43
PEDro	5
Total	331

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; PEDro, Physiotherapy Evidence Database.

June 29, 2020

	Initial Results, n	After Duplicates Removed, n
PubMed	590	585
CINAHL	357	97
Cochrane Library	317	242
PEDro	10	4
Total	1274	928

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; PEDro, Physiotherapy Evidence Database.

APPENDIX C

INTERVENTION ARTICLES: INCLUSION AND EXCLUSION CRITERIA

Article Characteristics

Include

- English language
- Articles reporting analysis of data: systematic reviews, meta-analyses, randomized clinical trials
- Time frame: 2005 to date

Exclude

- Cohort studies, cross-sectional studies, case series, and case reports
- Study protocols
- Abstracts, press releases, newsletters, editorial letters
- Articles published in non–peer-reviewed publications (eg, theses)

Patient/Participant Characteristics

Include

- Studies using data from humans
- Participants 65 years of age and older (if mixed, the mean should be over 65)
- Participants with fragility/low-energy hip or proximal femur fracture
  - Intracapsular (femoral head and neck)
  - Extracapsular hip fracture
    - Trochanteric
    - Subtrochanteric/proximal femur (ICD-10 S72.2)
  - Displaced and nondisplaced
  - Include all surgical approaches (hemiarthroplasty and total arthroplasty, internal fixation: intramedullary nail, compression screws, plate and screws)
  - Weight-bearing status
- If the study has hip fracture and other conditions, there must be at least enough patients (approximately n = 15 in each group) with hip fracture AND the results must be reported for hip fracture separately

Exclude

- Acetabular fracture only
- Primary hip replacement (not for hip fracture)
- Femoral shaft and distal femur fractures
- Fractures related to high-velocity/force multitrauma, gunshot, assault, cancer, or other pathologies
- Animal studies
- Articles with samples focusing on people younger than 65 years old
- Articles on healthy/normal participants
- Studies of primarily previously nonambulatory individuals
- Articles focusing on delivery models (often involving other countries) that are not focused on physical therapy delivery
- Orthogeriatric versus standard care, if focused on medical management or just the orthopaedic surgeon and geriatrician role

Exposure/Physical Therapy Interventions

Include

Articles on interventions within the scope of physical therapy practice for hip fracture, such as:

- Physical therapy intervention to prevent falls after fracture
- Coordination of care
- Team-based care that includes physical therapy (geriatric teams, hip fracture: orthopaedic/geriatric teams)
- Patient education and information provision
- Functional training
- Balance training
- Gait training
- Coordination training
- Assistive devices
- Aquatic physical therapy
- Community-based exercise and self-management programs
- Therapeutic exercise
  - Range of motion
  - Resistance/strength training
  - Proprioceptive neuromuscular facilitation
  - Flexibility/stretching
  - Aerobic and endurance exercises/activity
- Manual therapy
- Physical therapy electrophysical agents
  - Heat
  - Electrical stimulation
  - Ultrasound
  - Diathermy
- Hip protectors after hip fracture

Exclude

Articles that investigate only interventions outside the scope of physical therapy, such as:

- Surgical interventions (arthroplasty, open reduction internal fixation)
- Articles that report on:
  - Physical therapy interventions to prevent falls/fall-related hip fracture (primary prevention)
  - Disparities in rehabilitation input and outcome

Outcomes

Include

Studies with physical therapy treatment–relevant clinical outcomes, including:

- Lower extremity/leg strength
- Hip symptoms (eg, pain, stiffness)
- Physical function (including self-report and performance-based tests covering transfers, walking, carrying, activities of daily living, instrumental activities of daily living, etc)
  - Physical performance testing
  - 6-minute walk test
  - Timed up-and-go test

APPENDIX C

  - Gait speed
- Flexibility
- Gait
- Participation (eg, travel, work)
- Quality of life (excluded only if it is the sole outcome)
- Discharge disposition
- Economic outcomes (eg, cost, cost per quality-adjusted life-year, cost per life-year)

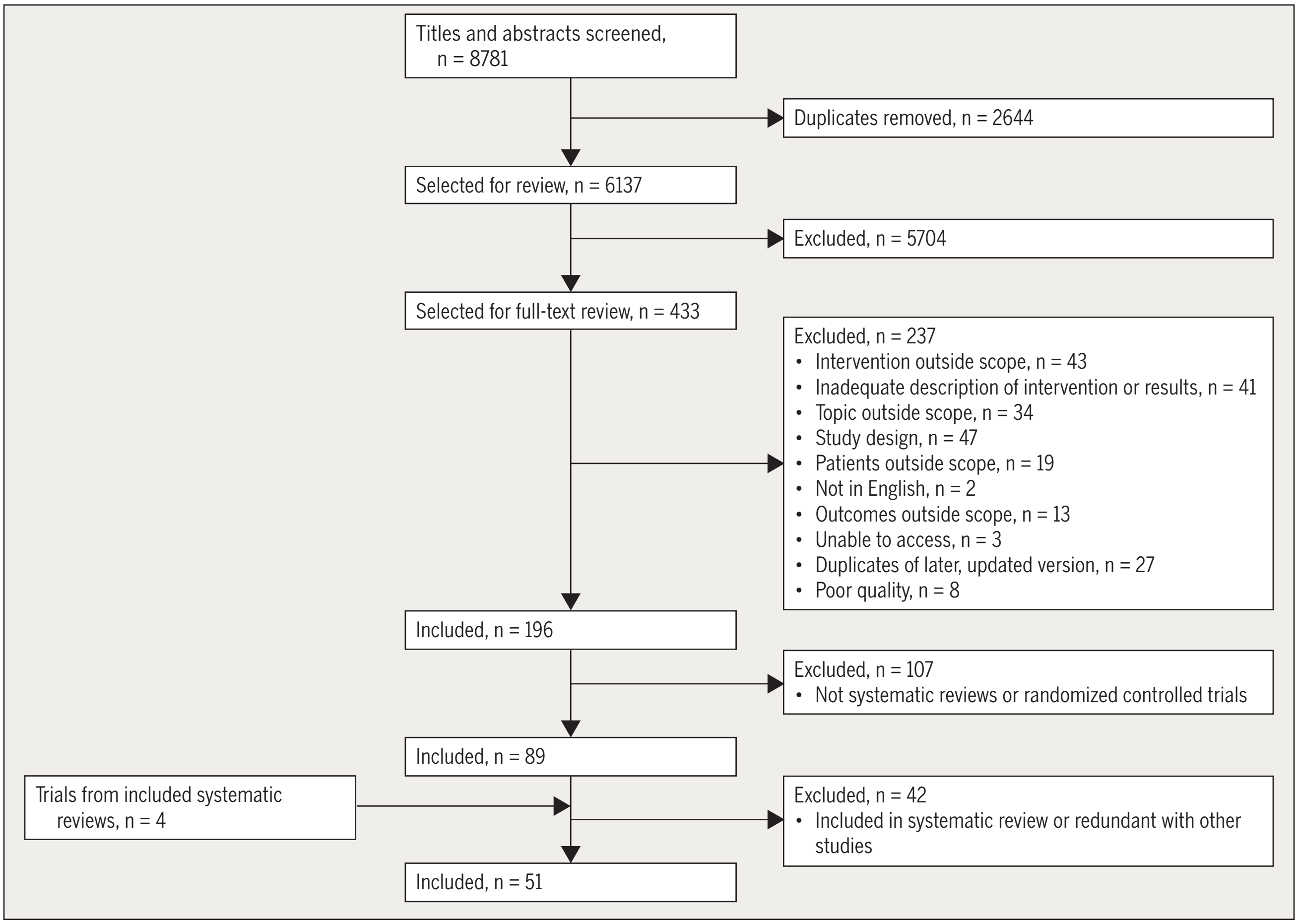
Exclude

Studies focused on surgical or laboratory outcomes, such as:
- Pathoanatomic features (eg, radiograph, ultrasound, or magnetic resonance imaging results, as they relate to surgery or other intervention)
- Surgery type (cemented, uncemented, etc)

Abbreviation: ICD-10, International Classification of Diseases, 10th revision.

APPENDIX D

FLOW CHART OF INTERVENTION ARTICLES (2005-2020)



APPENDIX E

LEVELS OF EVIDENCE[a]

Level	Intervention/Prevention	Pathoanatomic/Risk/Clinical Course/Prognosis/Differential Diagnosis	Diagnosis/Diagnostic Accuracy	Prevalence of Condition/Disorder	Exam/Outcomes
I	Systematic review of high-quality RCTs High-quality RCT[b]	Systematic review of prospective cohort studies High-quality prospective cohort study[c]	Systematic review of high-quality diagnostic studies High-quality diagnostic study[d] with validation	Systematic review, high-quality cross-sectional studies High-quality cross-sectional study[e]	Systematic review of prospective cohort studies High-quality prospective cohort study
II	Systematic review of high-quality cohort studies High-quality cohort study[c] Outcomes study or ecological study Lower-quality RCT[f]	Systematic review of retrospective cohort study Lower-quality prospective cohort study High-quality retrospective cohort study Consecutive cohort Outcomes study or ecological study	Systematic review of exploratory diagnostic studies or consecutive cohort studies High-quality exploratory diagnostic studies Consecutive retrospective cohort	Systematic review of studies that allows relevant estimate Lower-quality cross-sectional study	Systematic review of lower-quality prospective cohort studies Lower-quality prospective cohort study
III	Systematic reviews of case-control studies High-quality case-control study Lower-quality cohort study	Lower-quality retrospective cohort study High-quality cross-sectional study Case-control study	Lower-quality exploratory diagnostic studies Nonconsecutive retrospective cohort	Local nonrandom study	High-quality cross-sectional study
IV	Case series	Case series	Case-control study		Lower-quality cross-sectional study
V	Expert opinion	Expert opinion	Expert opinion	Expert opinion	Expert opinion

Abbreviation: RCT, randomized clinical trial.
[a]*Adapted from Phillips et al.*[219] *See also* **APPENDIX F.**
[b]*High quality includes RCTs with greater than 80% follow-up, blinding, and appropriate randomization procedures.*
[c]*High-quality cohort study includes greater than 80% follow-up.*
[d]*High-quality diagnostic study includes consistently applied reference standard and blinding.*
[e]*High-quality prevalence study is a cross-sectional study that uses a local and current random sample or censuses.*
[f]*Weaker diagnostic criteria and reference standards, improper randomization, no blinding, and less than 80% follow-up may add bias and threats to validity.*

APPENDIX F

PROCEDURES FOR ASSIGNING LEVELS OF EVIDENCE

- Level of evidence is assigned based on the study design using the Levels of Evidence table (**APPENDIX E**), assuming high quality (eg, for intervention, randomized clinical trial starts at level I)
- Study quality is assessed using the critical appraisal tool, and the study is assigned 1 of 4 overall quality ratings based on the critical appraisal results
- Level of evidence assignment is adjusted based on the overall quality rating:
  - High quality (high confidence in the estimate/results): study remains at assigned level of evidence (eg, if the randomized clinical trial is rated high quality, its final assignment is level I). High quality should include:
    - Randomized clinical trial with greater than 80% follow-up, blinding, and appropriate randomization procedures
    - Cohort study includes greater than 80% follow-up
    - Diagnostic study includes consistently applied reference standard and blinding
    - Prevalence study is a cross-sectional study that uses a local and current random sample or censuses
  - Acceptable quality (the study does not meet requirements for high quality and weaknesses limit the confidence in the accuracy of the estimate): downgrade 1 level
    - Based on critical appraisal results
  - Low quality: the study has significant limitations that substantially limit confidence in the estimate: downgrade 2 levels
    - Based on critical appraisal results
  - Unacceptable quality: serious limitations—exclude from consideration in the guideline
    - Based on critical appraisal results

APPENDIX G

ADDITIONAL INTRAINDIVIDUAL/PERSONAL RISK FACTORS INFLUENCING FUNCTIONAL OUTCOMES AND MORTALITY OF OLDER ADULTS WITH HIP FRACTURE

Factor	Adverse Outcome
Male sex	Higher morbidity and mortality in the hospital and at 1 y[2,7,8,28,29,31,33,52,58,60] and higher mortality up to 5 y[42,58]—increased complications during acute hospitalization[5] Less likely to return home 4 mo post fracture[28] In contrast, no differences in in-hospital outcome[39] Less able to cope with functional dependence[54]
Living alone or in assisted living/extended care/long-term care facility (includes hospitalized older adults)	Functional decline[10,56]
Polypharmacy	Decline in physical functioning (activities of daily living), falls[9,10] Greater fall risk during inpatient rehabilitation[56]
Knee extension strength deficit	Associated with greater than 50% deficits on the fractured side acutely post surgery[38,53] Knee extension strength on the fractured side is a strong predictor of short- and long-term gait speed and functional performance[45]
Blood laboratory values on admission	
Albumin, <3.5 g/dL	Increased length of stay and mortality[36]
Total lymphocyte count, <1500	Increased mortality[36]
Hemoglobin, <12 (female) and <13 g/dL (male)	Increased length of stay and mortality[23]
Parathyroid hormone, >6.8 pmol/L	Increased risk of in-hospital death[35]
Inadequate nutrition (body mass index, <24 kg/m^2)	Increased risk of intertrochanteric hip fracture, greater dependence of prefracture activities of daily living function[4] Weak evidence exists for the effectiveness of protein/energy supplements[3] Significantly associated with Barthel index scores[15]
Vitamin D deficiency, ≤32 ng/mL	Deficiency was present in 96% of women with hip fracture, and poorer performance/higher fall rates when 9 ng/mL or less[44]
Impaired perception and vision	Falls, fracture[9]
Subtrochanteric/intertrochanteric fracture versus femoral neck fracture	Increased mortality at discharge and at 1 y; decreased functional mobility at discharge for intertrochanteric fracture[18,20,21,27,38-40,60] In contrast, higher Functional Independence Measure scores at 1 y for intertrochanteric[1] 12 studies cited did not find fracture type to independently predict outcomes[9,42]
Ipsilateral hip abduction weakness or lower extremity contractures	Need assistance with ambulation at 60 d[6]
Admit urinary incontinence	Increased rate of complications[48]
• Foley catheter	Decline in activities of daily living functioning[10]
Thigh edema	Mobility deficits, increased postural sway, ipsilateral quadriceps weakness[38]
Hip fracture surgery	High risk for venous thromboembolism[22]
Delay in surgery	Greater than 24 h: increased incidence of deep venous thrombosis[57] Greater than 4 d: increased mortality, increased length of stay[35,51]
Low-molecular-weight heparin deep venous thrombosis prophylaxis	Increased frequency/severity of wound infection compared with mechanical prophylaxis[55]
Blood transfusion	Increased mortality more than 90 d post surgery[55] Increased risk of infection, pneumonia[11]
Perioperative blood loss	Increased length of stay, impeded functional mobility after surgery, increased complications[16]
Postoperative anemia	Early postoperative mobility deficits, predictive of not regaining functional mobility after surgery[18,30]
Postoperative hemoglobin, <8.0 g/dL	Increased mortality overall, and higher in those with pre-existing cardiac disease[12,13]
Depressive symptoms	Longer length of stay, lower functional recovery, increased 1-y mortality[25,34]
Postfracture hip pain	Functional dependence at 3 mo[14] Not monitoring/managing pain was associated with higher 30-d mortality[49] Reduced acute hospital mobility related to hip pain; pain-limited functional performance on hospital discharge was dependent on fracture type and procedure[37,47] Inadequate opioid analgesia increased risk of delirium[46]

Table continues on page CPG58.

APPENDIX G

Factor	Adverse Outcome
Delayed ambulation	New-onset delirium, pneumonia, increased length of stay[32]
Initial ambulation later than postoperative day 2	Increased length of stay, decreased gait[50]
Initial ambulation: less than 24 h versus greater than 48 h	Increased mortality, increased complications during acute hospitalization[5]
Weight-bearing status	
Non–weight bearing 2-4 wk after surgery	Lower Functional Independence Measure scores, increased mortality at 3 mo and 1 y[1]
Surgical/orthopaedic weight-bearing restrictions (less than full weight bearing)	Increased length of stay, decreased mobility[48,61] Decreased functional outcome during acute hospitalization[5]
Reduced ambulation during postoperative days 1-3	Increased mortality[17]
Less physical therapy on or before postoperative day 3 and fewer total sessions	Decreased mobility[51]
Start of physical therapy more than 2 d after surgery	Increased length of stay[59]
Physical therapy daily or less frequently	Less likely to be discharged to home[24]
American Society of Anesthesiologists score of 3 or greater	Increased 1-y mortality[2,8,35] Increased complications during acute hospitalization[25]
Higher American Society of Anesthesiologists score (1 is normal, 6 is brain-dead)	Increased mortality up to 5 y[42]
Early/acute hospital: impaired mobility	
Timed up-and-go score less than 24 s at discharge	Predictive of nonfalls at 6 mo[41]
Low ambulatory status on postoperative days 1-3	Associated with more 30-d medical complications, increased mortality, and less discharge to previous residence[17]
Loss of prefracture ambulatory status at hospital discharge	Associated with increased long-term mortality[42]
Prefracture New Mobility Score[43]	Not being able to regain basic mobility was associated with greater risk of death at 1 and 5 y after fracture[42]
Cumulated Ambulation Score less than 6[19]	

REFERENCES

1. Ariza-Vega P, Jiménez-Moleón JJ, Kristensen MT. Non-weight-bearing status compromises the functional level up to 1 yr after hip fracture surgery. *Am J Phys Med Rehabil*. 2014;93:641-648. https://doi.org/10.1097/PHM.0000000000000075
2. Ariza-Vega P, Kristensen MT, Martín-Martín L, Jiménez-Moleón JJ. Predictors of long-term mortality in older people with hip fracture. *Arch Phys Med Rehabil*. 2015;96:1215-1221. https://doi.org/10.1016/j.apmr.2015.01.023
3. Avenell A, Handoll HH. Nutritional supplementation for hip fracture aftercare in older people. *Cochrane Database Syst Rev*. 2010:CD001880. https://doi.org/10.1002/14651858.CD001880.pub5
4. Bachrach-Lindström M, Johansson T, Unosson M, Ek AC, Wahlström O. Nutritional status and functional capacity after femoral neck fractures: a prospective randomized one-year follow-up study. *Aging (Milano)*. 2000;12:366-374. https://doi.org/10.1007/BF03339862
5. Baer M, Neuhaus V, Pape HC, Ciritsis B. Influence of mobilization and weight bearing on in-hospital outcome in geriatric patients with hip fractures. *SICOT J*. 2019;5:4. https://doi.org/10.1051/sicotj/2019005
6. Barnes B, Dunovan K. Functional outcomes after hip fracture. *Phys Ther*. 1987;67:1675-1679. https://doi.org/10.1093/ptj/67.11.1675
7. Bentler SE, Liu L, Obrizan M, et al. The aftermath of hip fracture: discharge placement, functional status change, and mortality. *Am J Epidemiol*. 2009;170:1290-1299. https://doi.org/10.1093/aje/kwp266
8. Björkelund KB, Hommel A, Thorngren KG, Lundberg D, Larsson S. Factors at admission associated with 4 months outcome in elderly patients with hip fracture. *AANA J*. 2009;77:49-58.
9. Butler M, Forte M, Kane RL, et al. Treatment of common hip fractures. *Evid Rep Technol Assess (Full Rep)*. 2009:1-85.
10. Buurman BM, Hoogerduijn JG, van Gemert EA, de Haan RJ, Schuurmans MJ, de Rooij SE. Clinical characteristics and outcomes of hospitalized older patients with distinct risk profiles for functional decline: a prospective cohort study. *PLoS One*. 2012;7:e29621. https://doi.org/10.1371/journal.pone.0029621
11. Carson JL, Altman DG, Duff A, et al. Risk of bacterial infection associated with allogeneic blood transfusion among patients undergoing hip fracture repair. *Transfusion*. 1999;39:694-700. https://doi.org/10.1046/j.1537-2995.1999.39070694.x
12. Carson JL, Duff A, Poses RM, et al. Effect of anaemia and cardiovascular disease on surgical mortality and morbidity. *Lancet*. 1996;348:1055-1060. https://doi.org/10.1016/S0140-6736(96)04330-9
13. Carson JL, Noveck H, Berlin JA, Gould SA. Mortality and morbidity in patients with very low postoperative Hb levels who decline blood transfusion. *Transfusion*. 2002;42:812-818. https://doi.org/10.1046/j.1537-2995.2002.00123.x
14. Cree M, Carriere KC, Soskolne CL, Suarez-Almazor M. Functional dependence after hip fracture. *Am J Phys Med Rehabil*. 2001;80:736-743. https://doi.org/10.1097/00002060-200110000-00006
15. Di Monaco M, Castiglioni C, Vallero F, Di Monaco R, Tappero R. Appendicular lean mass does not mediate the significant association between vitamin D status and functional outcome in hip-fracture women. *Arch Phys Med Rehabil*. 2011;92:271-276. https://doi.org/10.1016/j.apmr.2010.09.028
16. Foss NB, Kehlet H. Hidden blood loss after surgery for hip fracture. *J Bone Joint Surg Br*. 2006;88:1053-1059. https://doi.org/10.1302/0301-620X.88B8.17534
17. Foss NB, Kehlet H. Short-term mortality in hip fracture patients admitted during weekends and holidays. *Br J Anaesth*. 2006;96:450-454. https://doi.org/10.1093/bja/ael012
18. Foss NB, Kristensen MT, Kehlet H. Anaemia impedes functional mobility after hip fracture surgery. *Age Ageing*. 2008;37:173-178. https://doi.org/10.1093/ageing/afm161
19. Foss NB, Kristensen MT, Kehlet H. Prediction of postoperative morbidity, mortality and rehabilitation in hip fracture patients: the cumulated ambulation score. *Clin Rehabil*. 2006;20:701-708. https://doi.org/10.1191/0269215506cre987oa
20. Fox KM, Cummings SR, Williams E, Stone K, Study of Osteoporotic Fractures. Femoral neck and intertrochanteric fractures have different risk factors: a prospective study. *Osteoporos Int*. 2000;11:1018-1023. https://doi.org/10.1007/s001980070022
21. Fox KM, Magaziner J, Hebel JR, Kenzora JE, Kashner TM. Intertrochanteric versus femoral neck hip fractures: differential characteristics, treatment, and sequelae. *J Gerontol A Biol Sci Med Sci*. 1999;54:M635-M640. https://doi.org/10.1093/gerona/54.12.m635
22. Geerts WH, Bergqvist D, Pineo GF, et al. Prevention of venous thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice

APPENDIX G

Guidelines (8th edition). *Chest*. 2008;133:381S-453S. https://doi.org/10.1378/chest.08-0656

23. Gruson KI, Aharonoff GB, Egol KA, Zuckerman JD, Koval KJ. The relationship between admission hemoglobin level and outcome after hip fracture. *J Orthop Trauma*. 2002;16:39-44. https://doi.org/10.1097/00005131-200201000-00009

24. Guccione AA, Fagerson TL, Anderson JJ. Regaining functional independence in the acute care setting following hip fracture. *Phys Ther*. 1996;76:818-826. https://doi.org/10.1093/ptj/76.8.818

25. Guerini F, Morghen S, Lucchi E, Bellelli G, Trabucchi M. Depressive symptoms and one year mortality among elderly patients discharged from a rehabilitation ward after orthopaedic surgery of the lower limbs. *Behav Neurol*. 2010;23:117-121. https://doi.org/10.3233/BEN-2010-0274

26. Hackett NJ, De Oliveira GS, Jain UK, Kim JY. ASA class is a reliable independent predictor of medical complications and mortality following surgery. *Int J Surg*. 2015 Jun;18:184-90. https://doi.org/10.1016/j.ijsu.2015.04.079.

27. Haentjens P, Autier P, Barette M, et al. Survival and functional outcome according to hip fracture type: a one-year prospective cohort study in elderly women with an intertrochanteric or femoral neck fracture. *Bone*. 2007;41:958-964. https://doi.org/10.1016/j.bone.2007.08.026

28. Holt G, Smith R, Duncan K, Hutchison JD, Gregori A. Gender differences in epidemiology and outcome after hip fracture: evidence from the Scottish Hip Fracture Audit. *J Bone Joint Surg Br*. 2008;90:480-483. https://doi.org/10.1302/0301-620X.90B4.20264

29. Hommel A, Ulander K, Bjorkelund KB, Norrman PO, Wingstrand H, Thorngren KG. Influence of optimised treatment of people with hip fracture on time to operation, length of hospital stay, reoperations and mortality within 1 year. *Injury*. 2008;39:1164-1174. https://doi.org/10.1016/j.injury.2008.01.048

30. Hulsbaek S, Larsen RF, Troelsen A. Predictors of not regaining basic mobility after hip fracture surgery. *Disabil Rehabil*. 2015;37:1739-1744. https://doi.org/10.3109/09638288.2014.974836

31. Jiang HX, Majumdar SR, Dick DA, et al. Development and initial validation of a risk score for predicting in-hospital and 1-year mortality in patients with hip fractures. *J Bone Miner Res*. 2005;20:494-500. https://doi.org/10.1359/JBMR.041133

32. Kamel HK, Iqbal MA, Mogallapu R, Maas D, Hoffmann RG. Time to ambulation after hip fracture surgery: relation to hospitalization outcomes. *J Gerontol A Biol Sci Med Sci*. 2003;58:1042-1045. https://doi.org/10.1093/gerona/58.11.m1042

33. Kannegaard PN, van der Mark S, Eiken P, Abrahamsen B. Excess mortality in men compared with women following a hip fracture. National analysis of comedications, comorbidity and survival. *Age Ageing*. 2010;39:203-209. https://doi.org/10.1093/ageing/afp221

34. Kaplan RM, Ganiats TG, Sieber WJ, Anderson JP. The Quality of Well-Being Scale: critical similarities and differences with SF-36. *Int J Qual Health Care*. 1998;10:509-520. https://doi.org/10.1093/intqhc/10.6.509

35. Karaca S, Ayhan E, Kesmezacar H, Uysal O. Hip fracture mortality: is it affected by anesthesia techniques? *Anesthesiol Res Pract*. 2012;2012:708754. https://doi.org/10.1155/2012/708754

36. Koval KJ, Maurer SG, Su ET, Aharonoff GB, Zuckerman JD. The effects of nutritional status on outcome after hip fracture. *J Orthop Trauma*. 1999;13:164-169. https://doi.org/10.1097/00005131-199903000-00003

37. Kristensen MT. Hip fracture–related pain strongly influences functional performance of patients with an intertrochanteric fracture upon discharge from the hospital. *PM R*. 2013;5:135-141. https://doi.org/10.1016/j.pmrj.2012.10.006

38. Kristensen MT, Bandholm T, Bencke J, Ekdahl C, Kehlet H. Knee-extension strength, postural control and function are related to fracture type and thigh edema in patients with hip fracture. *Clin Biomech (Bristol, Avon)*. 2009;24:218-224. https://doi.org/10.1016/j.clinbiomech.2008.10.003

39. Kristensen MT, Foss NB, Ekdahl C, Kehlet H. Prefracture functional level evaluated by the New Mobility Score predicts in-hospital outcome after hip fracture surgery. *Acta Orthop*. 2010;81:296-302. https://doi.org/10.3109/17453674.2010.487240

40. Kristensen MT, Foss NB, Kehlet H. Factors with independent influence on the 'timed up and go' test in patients with hip fracture. *Physiother Res Int*. 2009;14:30-41. https://doi.org/10.1002/pri.414

41. Kristensen MT, Foss NB, Kehlet H. Timed "Up & Go" Test as a predictor of falls within 6 months after hip fracture surgery. *Phys Ther*. 2007;87:24-30. https://doi.org/10.2522/ptj.20050271

42. Kristensen MT, Kehlet H. The basic mobility status upon acute hospital discharge is an independent risk factor for mortality up to 5 years after hip fracture surgery. *Acta Orthop*. 2018;89:47-52. https://doi.org/10.1080/17453674.2017.1382038

43. Kristensen MT, Kehlet H. Most patients regain prefracture basic mobility after hip fracture surgery in a fast-track programme. *Dan Med J*. 2012;59:A4447.

44. LeBoff MS, Hawkes WG, Glowacki J, Yu-Yahiro J, Hurwitz S, Magaziner J. Vitamin D-deficiency and post-fracture changes in lower extremity function and falls in women with hip fractures. *Osteoporos Int*. 2008;19:1283-1290. https://doi.org/10.1007/s00198-008-0582-6

45. Madsen OR, Lauridsen UB, Sørensen OH. Quadriceps strength in women with a previous hip fracture: relationships to physical ability and bone mass. *Scand J Rehabil Med*. 2000;32:37-40.

46. Morrison RS, Magaziner J, Gilbert M, et al. Relationship between pain and opioid analgesics on the development of delirium following hip fracture. *J Gerontol A Biol Sci Med Sci*. 2003;58:76-81. https://doi.org/10.1093/gerona/58.1.m76

47. Münter KH, Clemmesen CG, Foss NB, Palm H, Kristensen MT. Fatigue and pain limit independent mobility and physiotherapy after hip fracture surgery. *Disabil Rehabil*. 2018;40:1808-1816. https://doi.org/10.1080/09638288.2017.1314556

48. Myers AH, Palmer MH, Engel BT, Warrenfeltz DJ, Parker JA. Mobility in older patients with hip fractures: examining prefracture status, complications, and outcomes at discharge from the acute-care hospital. *J Orthop Trauma*. 1996;10:99-107. https://doi.org/10.1097/00005131-199602000-00005

49. Nielsen KA, Jensen NC, Jensen CM, et al. Quality of care and 30 day mortality among patients with hip fractures: a nationwide cohort study. *BMC Health Serv Res*. 2009;9:186. https://doi.org/10.1186/1472-6963-9-186

50. Oldmeadow LB, Edwards ER, Kimmel LA, Kipen E, Robertson VJ, Bailey MJ. No rest for the wounded: early ambulation after hip surgery accelerates recovery. *ANZ J Surg*. 2006;76:607-611. https://doi.org/10.1111/j.1445-2197.2006.03786.x

51. Penrod JD, Boockvar KS, Litke A, et al. Physical therapy and mobility 2 and 6 months after hip fracture. *J Am Geriatr Soc*. 2004;52:1114-1120. https://doi.org/10.1111/j.1532-5415.2004.52309.x

52. Penrod JD, Litke A, Hawkes WG, et al. The association of race, gender, and comorbidity with mortality and function after hip fracture. *J Gerontol A Biol Sci Med Sci*. 2008;63:867-872. https://doi.org/10.1093/gerona/63.8.867

53. Portegijs E, Sipilä S, Rantanen T, Lamb SE. Leg extension power deficit and mobility limitation in women recovering from hip fracture. *Am J Phys Med Rehabil*. 2008;87:363-370. https://doi.org/10.1097/PHM.0b013e318164a9e2

54. Samuelsson B, Hedström MI, Ponzer S, et al. Gender differences and cognitive aspects on functional outcome after hip fracture—a 2 years' follow-up of 2,134 patients. *Age Ageing*. 2009;38:686-692. https://doi.org/10.1093/ageing/afp169

55. Sanchez-Ballester J, Smith M, Hassan K, Kershaw S, Elsworth CS, Jacobs L. Wound infection in the management of hip fractures: a comparison between low-molecular weight heparin and mechanical prophylaxis. *Acta Orthop Belg*. 2005;71:55-59.

56. Semel J, Gray JM, Ahn HJ, Nasr H, Chen JJ. Predictors of outcome following hip fracture rehabilitation. *PM R*. 2010;2:799-805. https://doi.org/10.1016/j.pmrj.2010.04.019

57. Smith EB, Parvizi J, Purtill JJ. Delayed surgery for patients with femur and hip fractures—risk of deep venous thrombosis. *J Trauma*. 2011;70:E113-E116. https://doi.org/10.1097/TA.0b013e31821b8768

58. Söderqvist A, Miedel R, Ponzer S, Tidermark J. The influence of cognitive function on outcome after a hip fracture. *J Bone Joint Surg Am*. 2006;88:2115-2123.

59. Takahashi C, Fushimi K, Matsuda S. Factors associated with a protracted hospital stay after hip fracture surgery in Japan. *Geriatr Gerontol Int*. 2011;11:474-481. https://doi.org/10.1111/j.1447-0594.2011.00711.x

60. Thorngren KG, Norrman PO, Hommel A, Cedervall M, Thorngren J, Wingstrand H. Influence of age, sex, fracture type and pre-fracture living on rehabilitation pattern after hip fracture in the elderly. *Disabil Rehabil*. 2005;27:1091-1097. https://doi.org/10.1080/09638280500056402

61. Wu J, Kurrle S, Cameron ID. Restricted weight bearing after hip fracture surgery in the elderly: economic costs and health outcomes. *J Eval Clin Pract*. 2009;15:217-219. https://doi.org/10.1111/j.1365-2753.2008.00943.x

APPENDIX H

SURGERY-RELATED FACTORS ASSOCIATED WITH OUTCOMES

Fracture/Surgical Consideration	Treatment/Procedure	Risk/Outcome
Nondisplaced intracapsular	Conservative versus surgical treatment	Surgical intervention decreases risk of fracture displacement and allows for early mobilization. Arthroplasty recommended for older, less fit individuals and open reduction internal fixation for more fit individuals 65 to 70 y old[3] Higher morbidity and mortality and longer hospital stays with nonoperative course[1,2]
Displaced intracapsular	Open reduction internal fixation for active people Hemiarthroplasty for less mobile, older adults Total hip arthroplasty	More complications with open reduction internal fixation versus arthroplasty[3] Better outcome with arthroplasty versus open reduction internal fixation: lower reoperation rate and pain scores, better functional status, and/or lower complication rate[1,2] Total hip arthroplasty: lower pain scores and lower revision rates (acetabular wear) versus hemiarthroplasty.[1,2] Higher dislocation rate than hemiarthroplasty in general and in people with dementia[3]
Stable intertrochanteric	Cephalomedullary nail versus sliding hip screw	Nail has decreased operative time and blood loss versus sliding hip screw[1,2] Nail has increased rate of intraoperative and postoperative fractures[3]
Unstable intertrochanteric	Cephalomedullary nail versus sliding hip screw	Nail leads to improved postoperative walking ability, fewer blood transfusions[1,2] Nail has decreased limb shortening versus sliding hip screw[1,2] Similar mortality and functional results between devices[1,2] No difference in pain[1,2]
Reverse oblique, transverse intertrochanteric	Cephalomedullary nail versus sliding hip screw	Nail has lower failure rates, blood loss, operating-room time[1,2]
Subtrochanteric	Cephalomedullary nail versus extramedullary fixation	Lower complication rate with cephalomedullary nail versus sliding hip screws, fixed-angle device, or extramedullary fixation[1,2]
Surgical approach	Anterolateral (transgluteal, modified Hardinge) Posterior (Southern or Moore, dorsal) Anterior	Modified Hardinge: decreased dislocation rates versus posterior[1,2] Increased dislocation rate and thrombosis versus anterior[3] Increased operative time, blood loss, and infection versus posterior[3]
Femoral stem	Cemented versus press fit	Higher fracture risk with press fit versus cemented[3]
Deep venous thrombosis/venous thromboembolism/pulmonary embolism	Pharmacological prophylaxis Mechanical prophylaxis	Lower risk of deep venous thrombosis/venous thromboembolism/pulmonary embolism complications with pharmacological or mechanical prophylaxis versus placebo[1,2] Pharmacological had a higher rate of hematoma complications versus placebo[1,2] Decreased deep venous thrombosis with 7-10 d of impulse system and compression stockings versus compression stockings only[1,2]

REFERENCES

1. Brox WT, Roberts KC, Taksali S, et al. The American Academy of Orthopaedic Surgeons Evidence-Based Guideline on Management of Hip Fractures in the Elderly. *J Bone Joint Surg Am*. 2015;97:1196-1199. https://doi.org/10.2106/JBJS.O.00229
2. Roberts KC, Brox WT. AAOS Clinical Practice Guideline: Management of Hip Fractures in the Elderly. *J Am Acad Orthop Surg*. 2015;23:138-140. https://doi.org/10.5435/JAAOS-D-14-00433
3. Scottish Intercollegiate Guidelines Network. Management of Hip Fracture in Older People: A National Clinical Guideline. Edinburgh, UK: Scottish Intercollegiate Guidelines Network; 2009.

APPENDIX I

DETAILED SUMMARY OF MEASURES

BODY FUNCTIONS AND STRUCTURES – PHYSICAL IMPAIRMENT MEASURES

Lower Extremity Muscle Strength/Power

Construct Measured and ICF Level

Measurement of impairment of body function: strength of single joint.

Description and Discussion

Knee extension strength of the fractured side approximately 2 weeks after fracture is on average reduced by more than 50% compared to the nonfractured side.[54,75,93] Knee extension, hip extension, and hip abduction can be assessed using different strength testing devices, for example, a dynamometer, a "spring balance," the Nottingham power rig, an isokinetic muscle strength testing device, and free weights or resistance training machines for repetition-maximum (RM) testing (eg, weight load lifted during a 10-RM test). A handheld dynamometer is commonly used for patients with hip fracture.[65,92] A belt/strap-fixated approach is recommended to conduct a "make test," where the patient holds maximal isometric contractions for 3 to 5 seconds. For the frailest/weakest, manual muscle testing may be used.[10]

- Scoring: strength is scored as Newtons, kilograms, or pounds and reported as such or adjusted for the lever arm (eg, Newton meters) or body weight, normalized as Newtons per kilogram or Newton meters per kilogram, while power is reported as watts. A practice trial is commonly used before test trials, including a minimum of 60 seconds of rest between trials to reduce the effect of muscle fatigue. Verbal encouragement should be given during testing to encourage maximal effort, and the highest ("strongest") value should be used as the result.[65,72]
- Time to administer: 5 to 10 minutes per leg, depending on number of trials, type of strength testing approach, and equipment used
- Equipment required: a handheld dynamometer, spring balance,[92] or fixated handheld dynamometer[65] is often used for strength testing, while a Nottingham power rig is often used for power testing[8]
- Training required and resources available: familiarization with equipment and practice with testing procedures are needed before real-life testing
- Assistive devices: belt for fixation if using a handheld dynamometer

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Intrarater reliability for the affected and unaffected legs for knee and hip strength using a dynamometer was rated as "excellent" (intraclass correlation coefficient [ICC]$\geq$0.75)[92]
- Intrarater and test-retest reliability was established in the acute phase of hip fracture recovery for hip abduction, hip flexion, and knee extension.[50,92] The ICC for the fractured limb was 0.80 or greater and for the nonfractured limb was 0.69 or greater
- Test-retest reliability ($ICC_{1,1}$) of knee extension strength, with a belt-fixated handheld dynamometer (based on 3 consecutive assessments in the same session), of 75 patients with hip fracture (mean $\pm$ SD, 26.4 $\pm$ 8.4 days post surgery). The ICC for the fractured limb was 0.95. The standard error of measurement (SEM) of the fractured limb was 1.0 kg and the minimum detectable change (MDC_{90}) was 2.3 kg. For the nonfractured limb, the ICC was 0.95, SEM was 1.6 kg, and MDC_{90} was 3.7 kg[50]

Validity

For older adults with hip fracture:

- Maximal isometric knee extension strength correlated with:
  - 10-m fast walking speed (mean, 8.5 days post surgery; r = 0.77 for the fractured limb and r = 0.80 for the unaffected limb, P<.001), in addition to significant associations with several other performance-based outcome measures.[54] Corresponding data were reported in an outpatient setting (mean $\pm$ SD, 17.5 $\pm$ 5.7 days post surgery)[78]
  - Fractured-limb thigh edema and knee extension strength deficit (as a percent of the unaffected limb)[54]: r = –0.77, P<.001
  - Correlations between the 6-minute walk test (6MWT) and lower extremity strength and power were r = 0.62 (95% confidence interval [CI]: 0.46, 0.75) and r = 0.72 (95% CI: 0.59, 0.82), respectively[67]
- In the acute hospital, a larger fractured-limb strength deficit (percent of nonfractured limb strength) was found for trochanteric fractures compared to femoral neck fractures[54,65]
- Strong positive correlations of knee extension strength with gait speed, and negative correlations with edema, were reported.[54,78] Positive correlations were found between knee extension strength and power and the 6MWT[67]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, Standardized Response Mean (SRM), Minimal Clinically Important Difference (MCID)

For older adults with hip fracture:

- Effect sizes for lower extremity strength training have been reported in systematic reviews of interventions conducted from 3 months to 1 year after fracture (0.42; 95% CI: 0.10, 0.74)[68] and from 3 weeks to years after fracture (0.47; 95% CI: 0.27, 0.66)[5]

Floor/Ceiling Issues

- None reported

How to Access/Resources

- Manual muscle testing: https://www.physio-pedia.com/Muscle_Strength
- 1-RM (or any multiple RM) testing: http://exercise.trekeducation.org/2017/10/01/10-rm-testing/

APPENDIX I

Reference Values

For older adults with hip fracture:

- Not established

For community-dwelling older adults[12]:

- A meta-analysis of 3 studies reported knee extension strength values standardized relative to body weight and reported as percent, by age and sex:
  - Age, 60-69 years
    - Men: 49% for the nondominant (n = 44) and 48% for the dominant (n = 46) side
    - Women: 39% for the nondominant (n = 49) and 41% for the dominant (n = 50) side
  - Age, 70-79 years
    - Men: 48% for the nondominant (n = 50) and 46% for the dominant (n = 51) side
    - Women: 36% for the nondominant (n = 47) and 38% for the dominant (n = 47) side

Recommended for Future Research in Older Adults With Hip Fracture

- Effect size, SRM, and MCID of muscle strength/power tests
- Predictive value
- Reliability of muscle power testing
- Reference values

Evidence Summary and Rationale

There was strong evidence for the reliability and validity of knee extensor strength and moderate evidence for hip strength. Clinical circumstances will affect the feasibility of the methods used. The importance of lower extremity strength to functional outcome provided additional support for this recommendation.

Recommendations

A Physical therapists must test and document knee extension strength across settings.

B Physical therapists should test and document hip muscle strength in postacute settings.

Verbal Rating (Ranking) Scale (VRS) for Pain

Construct Measured and ICF Level

The VRS for pain has been used to measure hip fracture–related pain in acute, postacute, and outpatient settings. It addresses the ICF level of impairment/body functions and structures.

Description and Discussion

The VRS is a patient-reported measure that can be used for pain at rest and during activity. Alternative pain scales exist, including the numeric rating scale (NRS, 0-10) or visual analog scale (VAS, 0-10 or 0-100). Test-retest reliability has been established, and the VRS 0-to-4-point scale has proven superior to the VAS in patients with hip fracture.[69] There is some evidence to support use in patients with cognitive impairment.[7]

- Scoring: to administer the VRS, the patient is asked, "Do you experience any pain in the area where you fractured your hip?" If the answer is yes, then the patient is asked whether the experienced pain is slight, moderate, severe, or unbearable. The score is rated on a 5-point ordinal scale: 0 is no pain, 1 is slight pain, 2 is moderate pain, 3 is severe pain, and 4 is unbearable pain.[7] Pain should be measured at rest and during activity, for example, during walking, sit-to-stand, and training
- Time to administer: less than 2 minutes
- Equipment required: none
- Training required and resources available: none
- Assistive devices: none

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Intrarater reliability by interview (mean, 3.6 days post surgery; linear weighted $\kappa = 0.75$; 95% CI: 0.65, 0.85) for the fractured leg at rest (1-minute interval between assessments) and during a passive straight leg raise ($\kappa = 0.68$; 95% CI: 0.59, 0.77) (3-minute interval)[7]
- Test-retest reliability assessed daily from before surgery to postoperative day 3 (measurement repeated after 10 minutes each day): Pearson's $r = 0.75$ to 0.93[69]

Validity

For older adults with hip fracture:

- Moderate to strong correlations were reported from before surgery to postoperative day 3 with the VAS ($r = 0.58$-0.77)[69]
- Adjusted odds ratio (OR) for the following variables: frequency of pain medication use (OR = 5.75; 95% CI: 2.23, 14.82; $P = .003$), Yesavage Mood Score (OR = 2.69; 95% CI: 1.18, 6.12; $P = .02$), and knee extension at 60°/s in the fractured limb (OR = 0.96; 95% CI: 0.92, 1.00; $P = .05$)[35]
- For patients in the acute-care hospital:
  - Higher pain scores in trochanteric hip fractures compared to cervical femoral fractures, and patients with moderate to severe pain performed worse on the timed up-and-go (TUG) test than those with no to slight pain[52]
  - Higher pain scores in surgery with "osteosynthesis" compared to arthroplasty[25]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

- Not established

Floor/Ceiling Issues

- None known

How to Access

- No formal version found

APPENDIX I

Recommended Future Research in Older Adults With Hip Fracture

- Establish reliability estimates in other settings than acute care
- Establish sensitivity to change and responsiveness

Evidence Summary and Rationale

Strong evidence, based on level I evidence, was found for the reliability and validity of the VRS for pain in older adults with hip fracture, and it was found to be clinically feasible.

Recommendation

A Physical therapists should administer and document the VRS for pain in all settings to monitor pain.

ACTIVITY LIMITATION – PHYSICAL PERFORMANCE MEASURES

5-Times Sit-to-Stand (5TSS) Test

Construct Measured and ICF Level

The 5TSS test is a mobility measure that tests the ability to perform transfers at the activity level.

Description and Discussion

The 5TSS (also called "chair rise") test is the most commonly used version of the original 10-times sit-to-stand test and its many versions (1, 3, and 5), which were initially developed as a proxy for lower extremity strength. This performance-based measure is conducted using a straight-backed chair (against a wall), by recording the time it takes to stand up and sit down 5 times with the arms folded across the chest.[15] The 5TSS is also included as part of the Short Physical Performance Battery (SPPB). The test is limited to higher-functioning patients because upper extremity use is not permitted. Five sit-to-stand transitions are required to register a score.[30,70] An alternative test, the 30-second chair rise, was developed within the Senior Fitness Test battery and counts the number of transitions one can perform in 30 seconds. Although measurement properties have been established in community-dwelling older adults,[89,90] there were no measurement studies in patients post hip fracture.

- Scoring: score is the time taken in seconds to complete the test. Lower scores indicate better mobility skills
- Time to administer: specific estimates are not identified in the literature, but it would appear that the test takes less than 5 minutes[30]
- Equipment required: standard armless chair, 43 to 45 cm high, with a back rest, and a stopwatch[11,76]
- Training required and resources available: training is not required
  - Administration recommendations are provided in the Academy of Neurologic Physical Therapy Core Outcome Measures guideline[76]
  - A downloadable instructional video is available as part of the SPPB: https://www.nia.nih.gov/research/labs/leps/short-physical-performance-battery-sppb
- Assistive devices: this test is performed without the use of assistive devices

Measurement Properties

Reliability and Precision

For older adults with hip fracture[19]:

- Interrater reliability between 3 and 12 weeks after fracture: ICC = 0.87 (95% CI: 0.77, 0.93)
- Test-retest reliability between 3 and 12 weeks after fracture: ICC = 0.91 (95% CI: 0.81, 0.96)

Validity

For older adults with hip fracture:

- Correlation between self-rated strength and chair-rise time: r = 0.22[21]
- Correlations between the 5TSS and the Medical Outcomes Study 12-Item Short-Form Health Survey (SF-12) subscales, Activity Measure for Post-Acute Care (AM-PAC), Lower Extremity Functional Scale, Oxford Hip Score, and NRS were nonsignificant (r = 0.15-0.40)[19]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID[21]

- Effect sizes ranged from 0.74 to 1.12
- Area under the curve (AUC), using the EuroQol-5 dimensions scale (EQ-5D) as the reference, was 0.66 (95% CI: 0.57, 0.75)

Floor/Ceiling Issues

- Floor effects for the 5TSS were the impetus for the use of the 30-second sit-to-stand (chair rise)[30,70]
- More than 88% of patients were not able to rise from a chair in the acute setting after hip fracture surgery (30-second chair-rise test)[37]

How to Access

- Centers for Disease Control and Prevention: https://www.youtube.com/watch?v=Ng-UOHjTejY

Recommended Future Research in Older Adults With Hip Fracture

- Determine reliability estimates, predictive validity, and SRM and MCID

Evidence Summary and Rationale

Moderate evidence, based on level II evidence, was found for the 5TSS. Although the evidence was specific to the 5TSS, the guideline development team (GDT) acknowledges the potential feasibility of the 30-second version of the test for patients who are unable to complete 5 repetitions. The 5TSS test is also recommended as a test to assess risk for falls in older adults. Because 90% of hip fractures are associated with a fall, fall-risk assessment and management are critical in this population. Refer to the fall-risk management guideline for specific recommendations.[6]

Recommendation

B Physical therapists should conduct and document the 5TSS or 30-second sit-to-stand test in postacute inpatient, home, and outpatient settings to measure mobility and fall risk.

APPENDIX I

6-Minute Walk Test

Construct Measured and ICF Level

The 6MWT measures walking endurance in older adults with hip fracture in postacute and outpatient rehabilitation settings[17,67,78,79] at the activity level.

Description and Discussion

The 6MWT is a performance-based measure of walking endurance in older adults with hip fracture in postacute and outpatient rehabilitation settings at the activity level.[17,67,78,79] Distance in meters is measured while an individual walks as far as possible without running and while using assistive devices, if needed, for 6 minutes on at least a 12-m walkway. Two cones are placed at each end of the 30-m walkway.[13] A study conducted in healthy community-dwelling older adults demonstrated no difference in walking distance with or without instructions to "walk as far or as fast as possible," but no similar study has been conducted in older adults with hip fracture.[96] Hip fracture–related pain was associated with performance on the 6MWT, and therefore pain during testing should be documented.[78,79]

- Scoring: score is the distance walked in 6 minutes. Higher scores indicate better performance
- Time to administer: approximately 10 minutes (6 minutes per trial and administration time)
- Equipment required: a 30-m walkway, 2 cones to mark each end of the walkway, a stopwatch, a chair to rest, and a recording sheet
- Training required and resources available:
  - Administration recommendations are provided in the Academy of Neurologic Physical Therapy Core Outcome Measures guideline[76]
  - Instructions can also be found in the American Thoracic Society statement[2]
- Assistive devices: the test can be performed with or without the use of assistive devices

Measurement Properties

Reliability and Precision

For older adults with hip fracture[79]:

- Interrater reliability in women, approximately 1 month after hip fracture surgery: $ICC_{2,1}$ = 0.92 (95% CI: 0.81, 0.97)
- SEM, 21.4 m
- MDC_{95}, 59.4 m
- MDC_{90} (with rollator), 49.8 m

Validity

For older adults with hip fracture:

- Correlations with lower extremity strength and power were r = 0.62 (95% CI: 0.46, 0.75) and r = 0.72 (95% CI: 0.59, 0.82), respectively, in inpatient, home, and outpatient settings[67]
- Strong correlation with the de Morton Mobility Index (DEMMI) score at admission to an inpatient setting and after discharge from an acute-care hospital (interquartile range, 6.8-17.3 days after hip fracture surgery; r = 0.76; 95% CI: 0.63, 0.85)[17]
- Moderate correlation (r = 0.6) between the 6MWT and knee extension strength (fractured limb); feasibility, approximately 8 weeks after hip fracture surgery[78]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- MCID, 35.4 m[17]
- Effect size, 1.42 (95% CI: 1.14, 1.71) for patients in postacute rehabilitation[17]
- Effect size, 0.99 over a 3-month period post fracture[67]
- Effect size, 0.80 in a sample of 48 over a period of 6 months post fracture[97]
- SRM, 1.11[67]

Floor/Ceiling Issues

- The earliest report of 6MWT administration was 17.5 days after surgery, indicating that there may be a perception of limited utility in the acute postoperative period. However, this test can be conducted on all patients who can walk[78]

How to Access

- Recommended standardized instructions are provided in the Academy of Neurologic Physical Therapy Core Outcome Measures[76]
- Overgaard et al[79] provided a complete description of the test execution and administration in older adults with hip fracture
- The American Thoracic Society provides detailed guidelines for administration of the 6MWT[2]

Recommended Future Research in Older Adults With Hip Fracture

- Reliability estimation in a sample including both sexes
- Reference values across the continuum of care and recovery

Evidence Summary and Rationale

There is strong evidence, based on level II evidence, for the reliability and validity of the 6MWT for older adults with hip fracture. In addition, it is a recommended measure within the Academy of Neurologic Physical Therapy's Core Outcome Measures.

Recommendation

B Physical therapists should use the 6MWT in postacute and community settings when the patient does not require the therapist's assistance to walk and when there is an adequate length of corridor to conduct the test.

Gait Speed

Construct Measured and ICF Level

Gait speed is a performance-based measure of walking distance and time (activity).

Description and Discussion

Gait speed has been measured over various walking course lengths and is included as part of the SPPB. Gait speed has been studied in patients post hip fracture and can be used in all settings and at

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all phases of recovery; however, factors such as instructions, pace, distance walked, assistance, and assistive-device use all impact the outcomes. Gait speed should be recorded only for those individuals who do not need human assistance to walk.

- Scoring: score is the quotient of a fixed distance divided by the time taken to walk the distance. The international measurement unit is meters per second. Faster speeds indicate better function
- Time to administer: specific estimates are not identified in the literature. We estimate that the test will take less than 2 minutes
- Equipment required: measuring tape and a stopwatch. Instructions vary from a standing start to walking 2 m prior to starting the stopwatch. Patients can be instructed to walk at their normal pace or can be instructed to walk as fast as possible without running. Distances range from 4 to 500 m. A change in assistive devices can affect gait speed over the course of recovery
- Training required and resources available: a manual and instructional video are available as part of the National Institutes of Health Toolbox 4-m walk gait speed test or as part of the SPPB: https://nihtoolbox.my.salesforce.com/sfc/p/#2E000001H4ee/a/2E000000UZC2/jYm7Frz1.UHQtd0ofpQrPmErFxQuMIJkIWnsxKIzkMg
- Assistive devices: the test is performed with or without the use of assistive devices

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Test-retest reliability at a comfortable pace: $ICC_{3,1}$ = 0.97 (95% CI: 0.93, 0.98) and a fast pace: $ICC_{3,1}$ = 0.94 (95% CI: 0.87, 0.97)[92]
- MDC_{95} values for habitual and fast speeds were 0.08 and 0.10 m/s, respectively[80]
- MDC_{95} range in patients 2 to 120 months post fracture (mean, 9 months) was 0.08 to 0.17 m/s[80]

Validity

For older adults with hip fracture:

- At 12 weeks post fracture, correlation with lower extremity strength was r = 0.51 (95% CI: 0.32, 0.66) and with power was r = 0.58 (95% CI: 0.41, 0.72)[67]
- Correlation between 10-m fast gait speed and knee extension strength: r = 0.77 (fractured leg) and r = 0.80 (nonfractured leg) at acute-hospital discharge[54]
- Gait speed measured before hospital discharge predicted 12-month functional outcome as measured by the Barthel index[28]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect size ranged from 0.85 to 2.12[1,17]
- SRM ranged from 0.69 to 1.13 (depending on whether an assistive device was used)[67,91]
- MCID for normal gait speed was 0.10 m/s[80]

Floor/Ceiling Issues

- Not reported

How to Access

- National Institutes of Health Toolbox: https://www.healthmeasures.net/explore-measurement-systems/nih-toolbox

Recommended Future Research in Older Adults With Hip Fracture

- Investigation of the impact of assistive devices on estimates of MDC and reliability

Evidence Summary and Rationale

There is strong evidence, based on level I evidence, for the reliability and validity of gait speed as an outcome measure for older adults with hip fracture. However, improvement in gait speed may be limited by factors other than hip fracture rehabilitation, such as cardiorespiratory condition.

Recommendation

A Physical therapists should use the gait speed test in all settings when patients do not require human assistance. Documentation should include the features of test administration: comfortable or maximum speed, walking aid, and a rolling start or static start.

Short Physical Performance Battery

Construct Measured and ICF Level

This test was developed to measure balance, mobility, strength, and endurance at the activity level.

Description and Discussion

Activities include standing with feet together in side-by-side, semi-tandem, and tandem positions, time to walk 2.44 m (8 ft), and time to rise from a chair and return to the seated position 5 times.[30]

- Scoring: for the 2.44-m walk and 5-times chair stand, those who cannot complete the task are assigned a score of 0. Those completing the task are assigned a score of 1 to 4, corresponding to quartiles of time needed to complete the task, with the fastest times scored as 4. Standing balance tests are hierarchical in difficulty, and a single score of 0 to 4 is assigned for standing balance. Category scores for walking, chair stands, and balance tests are summed to create a summary performance scale
- Time to administer: 10 to 15 minutes
- Equipment required: straight-backed chair, stopwatch, tape measure, and pieces of tape or other ground marker
- Training required and resources available: online training module available at https://www.irp.nia.nih.gov/branches/leps/sppb/
- Assistive devices: can be used for walking test if needed

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Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- None were reported. Latham et al[67] used reliability estimated from older adults

Validity

For older adults with hip fracture[67]:

- Spearman correlations with self-reported measures (the AM-PAC and Medical Outcomes Study 36-Item Short-Form Health Survey [SF-36]) and other performance-based measures (physical functional performance test, gait speed, and 6MWT) range from 0.55 to 0.73 for the SPPB total score in patients recovering from a unilateral hip fracture with noncomplicated surgical repair
- Individuals who reported using an assistive device had worse SPPB total scores than those who did not within a sample of older adults recovering from a unilateral hip fracture with noncomplicated surgical repair

Responsiveness/Score Interpretation: Effect Size, SRM, MCID[67]

For older adults with hip fracture:

- Effect size: at 12-week follow-up, the effect size for the SPPB total score was Cohen's d = 1.18 in patients recovering from a unilateral hip fracture with noncomplicated surgical repair
- SRM at 12-week follow-up for the SPPB total score was 1.28 in patients recovering from a unilateral hip fracture with noncomplicated surgical repair
- MCID: no estimate was provided. The AUCs were 0.5 and 0.6 relative to achievement of 8 (a great deal improved) or greater on the global rating of change scale rated by the patient and provider, respectively, demonstrating acceptable responsiveness

Floor/Ceiling Issues

- Less than 10% for a floor or ceiling effect, depending on the time point of recovery[30]

How to Access

- Available for use without permission or royalty fees: https://www.nia.nih.gov/research/labs/leps/short-physical-performance-battery-sppb

Recommended Future Research in Older Adults With Hip Fracture

- Future research should address reliability estimates, predictive validity, responsiveness, and the MCID for adults after hip fracture

Evidence Summary and Rationale

There is level III evidence for the SPPB. It has been used in many large epidemiological studies of frail older adults. It includes important dimensions of functioning. However, the evidence on measurement properties specific to older adults with hip fracture is limited. This has impacted the level of evidence and strength of recommendation for this measure.

Recommendation

C Physical therapists may use the SPPB in all settings, though completion may not be feasible in the early postoperative period, depending on ability.

Timed Up-and-Go Test

Construct Measured and ICF Level

The TUG test measures functional mobility in the acute, postacute, and outpatient settings (body structure and function and activity).

Description and Discussion

The TUG test is a performance-based measure of the time it takes a person to stand up from a standard chair with arm rests (seat height of about 45 cm), walk 3 m to a line drawn on the floor, turn around, walk back to the chair, and sit down again. The original TUG manual[86] describes 1 practice followed by 1 timed trial, but many different versions exist. For example, between 1 timed trial and the average of 3 trials are seen in the literature, including for patients with hip fracture. Two studies where performances improved up to a third trial suggest that the fastest of 3 timed trials should be reported.[9,57] Also, the use of different walking aids when comparing performances between individuals and for measuring changes over time has been questioned.[56,59,91] Thus, patients with hip fracture who performed the TUG test with a walker used an average of 13.6 (95% CI: 11.2, 16.1) seconds more time to complete the TUG test than when using a 4-wheeled rollator.[56] Patients with hip fracture able to walk without an aid when admitted to a subacute rehabilitation setting showed greater improvements at follow-up when performing without a rollator.[91] Different instructions, such as the phrase "comfortable pace" or "as quickly and safe as possible," are commonly used and might influence performance. Thus, physical therapists should follow the same instructions/manual and be aware of the walking-aid influence when testing, retesting, and interpreting their results.

- Scoring: score is the time taken in seconds to complete the test. The stopwatch is started on the command, "Ready, go" and stopped when the test subject's buttocks touch the chair seat again. Using the score for the fastest of 3 trials is recommended[9]
- Time to administer: 5 minutes or less
- Equipment required: a standard firm chair with arm rests, a stopwatch, and a 3-m lane with room for turning
- Training required and resources available: no specific training
- Assistive devices: walking aid allowed, if needed

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Interrater reliability of the fastest of 3 timed trials (mean ± SD, 1.5 ± 0.6 hours between sessions) in 50 consecutive patients who used a mean ± SD of 21.8 ± 10.8 seconds to perform the TUG test with a rollator, within a mean ± SD of 9.9 ± 6 days post surgery at discharge from an acute orthopaedic ward: $ICC_{2,1}$ = 0.95 (95% CI: 0.92, 0.97); SEM, 2.4 seconds (SEM,

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11%); MDC_{95}, 6.8 seconds (MDC, 31%); MDC_{90}, 5.7 seconds[61]
- Interrater reliability at 12 weeks post surgery in 75 patients who used a mean ± SD of 16.8 ± 8.7 seconds to perform the TUG test (54% used a walker and 44% used a cane): $ICC_{2,1}$ = 0.97 (95% CI: 0.95, 0.98); SEM, 1.8 seconds; MDC_{90}, 3.2 seconds[19]

Validity

For older adults with hip fracture:
- Correlation with:
  - Functional Independence Measure (FIM) on admission to 24-hour rehabilitation facilities: $r = -0.47$, $P<.05$[73]
  - 10-m walking speed (as fast as possible) in 24-hour rehabilitation facilities on admission and at discharge: $r = 0.50$, $P = .03$ and $r = 0.73$, $P<.001$, respectively[26]
  - Lower extremity measure 6 weeks post hip fracture: $r = -0.53$, $P = .03$[41]
  - Fractured-limb knee extension strength at acute-hospital discharge: $r = -0.52$, $P = .02$[54]
  - SF-12 physical functioning: $r = -0.612$; AM-PAC-basic mobility: $r = -0.623$; Oxford Hip Score: $r = -0.394$, $P<.001$[19]
- Qualitative evidence
  - Evidence from 2 studies indicated that older adults with hip fracture found the TUG test relevant and similar to important daily activities.[19] Predictive validity:
    - Score on the TUG test assessed within the first 3 weeks post hip fracture was a strong predictor of walking ability and activity level at long-term follow-up.[40,66] While this was not the case for patients with trochanteric fractures in another study, scores below 60 seconds seem to predict 1-year function[77]
    - The 60-second cutoff point assessed with a walker seems to predict the ability to reach functional milestones at discharge from a subacute rehabilitation facility[27]
    - TUG test score less than 24 seconds at acute-hospital discharge predicts nonfallers within 6 months after hip fracture (negative predictive value, 93; 95% CI: 81, 100)[60]
- For patients in the acute-care hospital:
  - Older age, low prefracture function, a trochanteric fracture, and experiencing moderate to severe pain are associated with poorer TUG test performances[52,59]
  - Patients who use a walker or 2 crutches take significantly more time to complete the TUG test than when using a 4-wheeled rollator[56]
  - Low functioning is associated with poorer TUG test performance[19]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:
- SRM reported for 36 patients in 24-hour rehabilitation facilities (1 month post hip fracture) for TUG test times with and without a rollator (rolling walker): −0.76 and −0.77, respectively[91]
- MCID: anchor based, 2.5 seconds; distribution based, 4.6 seconds[19]

Floor/Ceiling Issues

- Appears to depend on the time point of testing after hip fracture surgery and the residential status. Fewer than 50% of patients (patients from a nursing home included) with trochanteric fractures were able to perform the TUG test at postsurgery day 5,[77] while approximately 70% of patients (all fracture types included) who were 60 years of age or older and admitted from their own home performed the TUG test by acute-hospital discharge[59]

How to Access

- Standardized TUG test instructions in English, used in the reliability study of patients with hip fracture[61] and in other studies from this group, are freely available as an appendix in Bloch et al[9]
- Standardized instructions, derived from Podsiadlo and Richardson,[86] are available but do not include information on "number of trials" and suggest that "customary walking aids should be used": see https://www.sralab.org/rehabilitation-measures

Reference Values

For older adults with hip fracture:
- Not established

For community-dwelling older adults:
- "The mean (95% CI) for 3 age groups were: 8.1 (7.1, 9.0) seconds for 60 to 69-year old adults, 9.2 (8.2, 10.2) seconds for 70 to 79 years, and 11.3 (10.0, 12.7) seconds for 80 to 99 years"[11]

Recommended Future Research in Older Adults With Hip Fracture

- Effect size, SRM, and MCID
- Reference values in older adults with hip fracture
- Consensus on which standardized TUG instructions/manual to be used

Evidence Summary and Rationale

There is strong evidence, based on level I evidence, for the TUG test in older adults with hip fracture. It is also a recommended measure for fall-risk assessment and prevention.[6,71] Therefore, it is strongly recommended by the GDT for use in patients with hip fracture to address mobility and fall risk.

Recommendation

A Physical therapists should use the TUG test in all settings to measure mobility and risk for falls when patients do not require human assistance. Documentation should include the features of test administration: comfortable or maximum speed and walking-aid use.

Cumulated Ambulation Score (CAS)

Construct Measured and ICF Level

The CAS can be used to measure the basic mobility status of patients with hip fracture and older medical/geriatric patients in acute and subacute settings (activity).

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Description and Discussion

The CAS is a performance-based measure (also used as patient or proxy reported) that evaluates the basic mobility status of patients' independence in 3 basic activities (getting in and out of bed, sit-to-stand-to-sit from a chair, and walking).[22,24,53] The CAS is an obligatory score in the nationwide Danish Multidisciplinary Hip Fracture Registry, with the prefracture and acute-hospital discharge scores being reported.[64] The CAS was recently included in the Irish Hip Fracture Database. The CAS can be used for all patients, independent of their functional and cognitive levels.

- Scoring: each of the 3 CAS activities is rated on a 3-point ordinal scale: 0 is not able to, despite human assistance and verbal cuing; 1 is able to, with human assistance and/or verbal cuing from 1 or more persons; and 2 is able to safely, without human assistance or verbal cuing. This results in a 1-day CAS score of 0 to 6 points.[53] Also, a 3-day cumulative CAS score of 0 to 18 points (postoperative days 1-3) has been used[24,53,85]
- Time to administer: less than 5 minutes when testing, but less when used in daily clinical practice
- Equipment required: bed, standard chair with arm rests (seat height of approximately 45 cm)
- Training required and resources available: no specific training required, but it is advised to read the standardized CAS manual before use (see link below)
- Assistive devices: allowed, if needed

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Interrater reliability of 1-day CAS score, assessed objectively by experienced and inexperienced users, within the first postsurgery week: weighted κ = 0.95 (95% CI: 0.92, 0.99); SEM, 0.20 points; MDC_{95}, 0.55 points[53]
- Interrater reliability of 1-day CAS score (Italian version), assessed objectively 48 hours and 3 months post surgery: weighted $\kappa \geq 0.95$ (95% CI: 0.90, 1.0); SEM, 0.13 or greater CAS points[29]
- Internal consistency, 1-day CAS: Cronbach $\alpha \geq .84$[29]
- Interrater reliability of 1-day CAS score (Spanish version), assessed objectively within the first postsurgery week: weighted κ = 0.83 (95% CI: 0.73, 0.94); observed agreement, 87%; internal consistency, Cronbach α = .89; SEM, 0.30; MDC, 0.83[4]

Validity

For older adults with hip fracture:

- Correlation in acute and postacute wards between the CAS and:
  - Physical performance based on the A-test, r = 0.91[101]
  - Activities of daily living (ADL) scale (first 4 items), $r \geq 0.85$[29]
  - Knee extension strength and 3-day CAS, r = 0.53 to 0.75[54]
  - Geriatric Depression Scale and 3-day CAS, r = –0.31[85]
  - Strong correlations were found between the CAS and the DEMMI (r = 0.76; 95% CI: 0.69, 0.81) and moderate correlations between the CAS and the Barthel index (r = 0.49; 95% CI: 0.39, 0.59)[37]
- Acute-hospital CAS score at discharge is predicted by age, prefracture function, place of fall, time to surgery, not completing physical therapy and anemia on the first postoperative day, and fracture type[23,38,58]
- CAS scores were predictive of outcomes
  - 3-day postsurgery CAS score (0-18 points) predicts length of stay, discharge destination, and 30-day mortality[24]
  - Prefracture CAS score predicts 4-month independent walking ability (nonparametric correlation [gamma] coefficient = 0.71; 95% CI: 0.36, 0.85)[84]
  - Odds of being discharged directly home were 4.9 times higher (adjusted analyses) for patients with a baseline (first postoperative mobilization) 1-day CAS score of 3 points or greater (AUC = 0.80)[37]
  - Odds of not surviving up to 5 years after fracture were 1.5 times higher for patients not reaching an independent CAS level at discharge[62]
  - National data from Denmark found a 2.8-fold higher risk of 30-day postdischarge mortality, plus increased risk of readmission, if prefracture CAS status was not recovered on acute-hospital discharge[64]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect size, 1.0 and MCID, 0.80 CAS points in the acute setting (postoperative day 1 to discharge)[37]

Floor/Ceiling Issues

For older adults with hip fracture:

- A ceiling effect was seen, as the CAS is designed as an early basic mobility score that is used until independence (CAS score, 6) or a lower prefracture level is reached. Thirty-five percent of patients reached the ceiling (independence) at acute-hospital discharge[37]

How to Access

- Approved CAS versions are available in the Danish, Swedish, Norwegian, Italian, Spanish, Indonesian, and English languages. Portuguese, Turkish, and Japanese versions are in preparation
- The CAS manual and score sheet in English and other languages are freely available from: https://www.researchgate.net/publication/337474968_The_Cumulated_Ambulation_Score_CAS_English_version_manual_and_score-sheet_updated_with_more_references_2019pdf

Reference Values for Older Patients With Hip Fracture

- Available from the nationwide Danish Multidisciplinary Hip Fracture Registry. The 2016 cohort included more than 5000 patients 65 years of age or older with hip fracture.[64] The percentage of patients with an independent prefracture basic mobility level (CAS score, 6) from the 5 regions in Denmark ranged from 74% to 88%. The percentage was reduced to less than 40% at acute-hospital discharge

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Recommended Future Research in Older Adults With Hip Fracture

- SRM, MCID
- More studies on long-term predictive value of acute-hospital CAS scores on outcome
- Reliability of prefracture CAS level (questionnaire-based assessment)

Evidence Summary and Rationale

There is strong evidence, based on level I evidence, for the reliability and validity of the CAS for patients with hip fracture working toward independence. It will necessarily be limited in value as an outcome measure after independence in walking and the 2 other activities has been achieved.

Recommendation

A Physical therapists should use the CAS in the acute and postacute settings to measure basic mobility until independence has been reached.

de Morton Mobility Index (DEMMI)

Construct Measured and ICF Level

Body function and structure and activity.

Description and Discussion

The DEMMI is administered by therapist observation of physical performance and consists of 15 hierarchical mobility items (3 bed, 3 chair, 4 static balance, 2 walking, and 3 dynamic balance items), each measured on a 2- (able/unable) or 3-point (able/partial/unable) scale.[16]

- Scoring: the total score is converted from a scale of 0 to 19 to an interval score range from 0 to 100, where 0 represents poor mobility and 100 indicates high levels of independent mobility
- Time to administer: approximately 10 to 15 minutes
- Equipment required: a chair with a 45-cm seat height and arm rests, a bed or plinth, protocol/scoring sheet, pen, shoes
- Training required and resources available: detailed instructions for scoring are provided in supplementary material in de Morton et al[16]
- Assistive devices: with or without an assistive device

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Not established

Validity

For older adults with hip fracture:

- Correlation between the DEMMI and the 6MWT (r = 0.76; 95% CI: 0.63, 0.85), 6-m walk test velocity (r = 0.62; 95% CI: 0.47, 0.73), and the Barthel index (r = 0.60; 95% CI: 0.46, 0.71)[17]
- Correlation between the DEMMI and the CAS was r = 0.76 (95% CI: 0.69, 0.81) and between the DEMMI and the Barthel index was r = 0.58 (95% CI: 0.48, 0.66)[37]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect size, 1.60 (95% CI: 1.42, 1.77)[17]
- Effect size, 0.78 (95% CI: 0.62, 0.97)[37]
- MCID, approximately 6 points[17]
- MCID, 8.16 (95% CI: 7.26, 9.09) points[37]

Floor/Ceiling Issues

For older adults with hip fracture:

- No floor or ceiling effect was found in a selected "homogeneous" group of patients with hip fracture admitted into a postacute rehabilitation facility a median of 10.0 days (interquartile range, 6.8-17.3 days) after surgery[17]
- A large floor effect was found at baseline on postoperative day 1 (39%) and at discharge (31%) at a mean ± SD of 9 ± 5.1 days after surgery[37]

How to Access

- An instructional handbook and education materials are available on the DEMMI website: http://www.demmi.org.au/
- The DEMMI may be printed or reproduced without alteration

Reference Values

For older adults with hip fracture:

- Not established

Recommended Future Research in Older Adults With Hip Fracture:

The DEMMI was initially developed in acute to postacute or inpatient rehabilitation/geriatric settings. Future research should target the use of the test in later stages of rehabilitation in older adults with hip fracture. Additional recommendations for future research are:

- Reliability and precision
- SRM
- Reference values
- Construct validity

Evidence Summary and Rationale

Although the content covered in the DEMMI is relevant for rehabilitation after hip fracture, there was no direct evidence for reliability of the DEMMI specific to older adults with hip fracture. This limited the level of evidence rating and strength of recommendation.

Recommendation

C Physical therapists may use the DEMMI in postacute and outpatient settings.

Functional Independence Measure (FIM)

Construct Measured and ICF Level

Level of disability and how much assistance is required (activity).

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Description and Discussion

The FIM provides motor and cognitive and ADL scores. The 13 motor tasks include eating; grooming; bathing; upper- and lower-body dressing; toileting; bladder and bowel management; bed to chair, toilet, and shower transfers; locomotion (ambulation or wheelchair); and stairs. The FIM is used in inpatient rehabilitation settings and is scored at admission and discharge by several members of the rehabilitation team. The FIM has been used as a recall questionnaire in some studies.

- Scoring: tasks are rated on a 7-point ordinal scale from total assistance to complete independence, with total FIM scores ranging from 18 (lowest) to 126 (highest function); the motor FIM scores range between 13 and 91
- Time to administer: 30 to 60 minutes
- Equipment required: none
- Training required and resources available: training required; a license is required to use the FIM

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- ICC = 0.74 on admission and ICC = 0.76 at discharge when comparing interviewer scores to team-based scores[102]
- ICCs ranged from 0.72 to 0.96 for comparisons between patient and proxy reprots at various time points post recovery[47]
- Test-retest reliability was rated adequate, with moderate-quality evidence in a systematic review of patient-reported measures in older people with hip fracture[34]

Validity

For older adults with hip fracture:

- Correlation of FIM scales with the TUG test ranged from r = −0.45 to −0.58, and with the Berg balance scale from r = 0.45 to 0.60[73]
- Correlation between the FIM basic movement and motor scales was r = 0.97 from postoperative weeks 2 to 12 for 54 patients with hip fracture. Correlation of changes in the 2 scales was r = 0.74[94]
- Validity was rated adequate, with moderate-quality evidence in a systematic review of patient-reported measures in older people with hip fracture[34]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect sizes, 0.9 and 2.3 over 6 months for cognitively intact people and people with cognitive impairment, respectively[48]

Floor/Ceiling Issues

- None reported in patients with hip fracture

How to Access

- https://www.udsmr.org/

Recommended Future Research in Older Adults With Hip Fracture

- Predictive validity across settings
- SRM, MCID

Evidence Summary and Rationale

As of October 2019, the FIM is not included on the Centers for Medicare and Medicaid Services mandated tools list. The requirement for training and licensing, and the move toward different mandated measures, has been reflected in the lower strength of recommendation: weak, based on level I evidence.

Recommendation

C Physical therapists may use the FIM in inpatient rehabilitation if they have been trained and have a license to use this measure.

ACTIVITY LIMITATION – SELF-REPORT MEASURES

New Mobility Score (NMS)

Construct Measured and ICF Level

Impairment/body structure and function and activity.

Description and Discussion

The NMS (also named the Parker mobility score in the literature) was originally developed as a questionnaire for all patients with hip fracture (including those with cognitive impairment) to describe the patient's prefracture ability to perform 3 activities: (1) indoor walking, (2) outdoor walking, and (3) walking during shopping.[63,81] The NMS is also used to assess the functional level at different time points following fracture.[49,78]

The prefracture functional level and older age are the strongest predictors of the outcome of patients with hip fracture, as shown in a large number of studies, including several using the NMS. Many patients do not regain their prefracture function following fracture, although this is considered an important minimum goal for all patients with hip fracture. Assessing the prefracture functional level is, therefore, extremely important for identification of high-risk patients who need special attention during rehabilitation.

- Scoring: each of the 3 activities is scored from 0 to 3: 0 is not able to, 1 is able to with help from another person, 2 is able to with a walking aid, and 3 is able to with no difficulty and no aid, resulting in a total score ranging from 0 (no walking ability at all) to 9 (fully independent)[63,81]
- Time to administer: about 1 minute
- Equipment required: scoring sheet, pencil
- Training required and resources available: no specific training is required, but it is advised to read the standardized NMS manual and the frequently asked questions before use (see link below)
- Assistive devices: not applicable

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Measurement Properties

Reliability and Precision[55]

For older adults with hip fracture:

- Interrater reliability between 1.5 and 3 days after surgery: $ICC_{2,1}$ = 0.98 (95% CI: 0.96, 0.99)
- SEM, 0.42 points
- MDC_{90}, 0.98 points

Validity

For older adults with hip fracture:

- Prefracture NMS score is significantly (*P*<.001) correlated with age (*r* = –0.584) and mental scores on admission (*r* = 0.612)[55]
- The NMS is correlated with the Falls Efficacy Scale-International (FES-I) (*r* = –0.67)[42]
- Prefracture NMS score is a strong predictor of the early postsurgery mobility outcome[23,38,58,59] and the 4-month outcome,[84] and for living at home after 1 year[82]
- Prefracture NMS score is a strong predictor of mortality, both in the short term[24] and long term[62,81]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

- Not established

Floor/Ceiling Issues

- A ceiling effect (NMS score, 9), similar to other questionnaires used to assess the prefracture functional level of consecutive cohorts, was seen for the prefracture NMS score, but not reported when used in the postfracture period

How to Access

- See Parker and Palmer[81] and online at https://www.researchgate.net/publication/338066657_English_version_of_the_Modified_New_Mobility_Score_NMS_language_edited_and_updated_with_new_references_Dec_2019pdf

Recommended Future Research in Older Adults With Hip Fracture

- More reliability estimates in community-dwelling older adults with hip fracture
- Validity: MCID, validity in all settings

Evidence Summary and Rationale

There was moderate evidence, based on level II evidence, for the reliability and validity of the NMS for older adults with hip fracture in postacute and community settings. The NMS can be used to measure prefracture and functional recovery status.

Recommendation

B Physical therapists should use the NMS in the early period/inpatient setting to assess prefracture status and in postacute and community settings to assess current status and recovery of prefracture status.

Falls Efficacy Scale-International (FES-I)

Construct Measured and ICF Level

Concern with falling; activity and participation.

Description and Discussion

This self-reported questionnaire asks the person to rate his or her concerns regarding falling while performing 16 activities. Questions range from concerns with basic ADL (such as getting dressed) to mobility activities (walking around in the neighborhood) to higher-level social or situational activities (going out to a social event or walking on an uneven surface). The FES-I was developed to expand on the 10-item, 100-point Falls Efficacy Scale,[99] which did not include more challenging activities or social situations; the 10-item version was also translated to Swedish and expanded to 13 items.[39] There is also a shortened version of the FES-I (short FES-I, 7-28 points) that includes 7 of the 16 activities and retains activities that are basic and demanding.[51]

- Scoring: scored with a 4-point Likert scale ("not at all concerned, somewhat concerned, fairly concerned, very concerned"). Scores range from 16 to 64 points, with higher values representing more concerns with fall-prone situations
- Time to administer: less than 5 minutes
- Equipment required: none
- Training required and resources available: training not required; translated into several languages

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- In patients receiving acute rehabilitation, the 16-item FES-I showed an ICC of 0.72 (95% CI: 0.52, 0.87), a SEM of 6.4 points, and an MDC_{95} of 17.7 points[100]

Validity

For older adults with hip fracture:

- Spearman correlation of the FES-I with avoidance of activity (*r* = 0.83), functional recovery score (*r* = –0.78), and mobility score (*r* = –0.67)[42]
- Spearman correlation of the FES-I with 1-item fear of falling: *r* = 0.68[100]
- A score greater than 21 was determined as the threshold for high fear of falling, based on measures of activity avoidance, functional recovery, and mobility[42]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- None reported

Floor/Ceiling Issues

- None reported in samples of older adults with hip fracture

How to Access

- https://sites.manchester.ac.uk/fes-i/

APPENDIX I

Recommended Future Research in Older Adults With Hip Fracture

- Reliability estimates
- Construct validity
- Effect size, SRM, MCID

Evidence Summary and Rationale

There is level II evidence for the reliability and validity of the FES-I in older adults with hip fracture. Because the majority of hip fractures are associated with falls, it is important that clinicians working with patients with hip fracture measure and address their falls self-efficacy.

Recommendation

B Physical therapists should use the FES-I to measure concern about falling in all settings.

Activity Measure for Post-Acute Care (AM-PAC)

Construct Measured and ICF Level

Activity construct. Three domains: applied cognition, daily activities, and mobility.[3,14,31,32,43]

Description and Discussion

The AM-PAC measures the extent of difficulty or assistance needed in performing specific functional tasks for 3 separate instruments or scales: basic mobility, daily activities addressing personal care and instrumental activities, and applied cognition, addressing cognitive functional activities. The AM-PAC was developed using item response theory methods, which support computer adaptive testing (CAT), or short, fixed forms based on a subset of items from the full item bank for each scale. There are several short forms in use, including the "6 Clicks" forms for inpatient provider proxy report.[18,44-46] The final item banks for the scales are 131 and 88 items for the basic mobility and daily activities scales, respectively. The calibration field study was conducted in 2 phases, using the combined data from the total convenience sample of 1035 adults participating in rehabilitation for a range of clinical conditions, including neurologic (eg, stroke, brain injury, Parkinson's disease, and multiple sclerosis), medically complex (eg, postsurgical and cardiopulmonary conditions), and musculoskeletal (hip and other fractures and orthopaedic surgeries such as joint replacement). Data were collected in acute rehabilitation, skilled nursing, outpatient, and home care rehabilitation settings by trained interviewers within 6 regional rehabilitation networks.

- Scoring: AM-PAC scores are reported as T scores, with a mean ± SD of 50 ± 10. Lower scores represent lower mobility and higher scores represent higher mobility
- Time to administer: each scale of the AM-PAC can be administered in 2 to 3 minutes
- Equipment required: either computer access (for the CAT version) and initial access to the internet to download the software, or pencil and paper for the short-form version
- Training required and resources available: read the manual specific to the version used, available at www.Pearsonassessments.com/AMPAC or www.am-pac.com
- Assistive devices: the short-form questions are answered based on difficulty performing tasks without special equipment

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- None reported

Validity

For older adults with hip fracture:

- Correlations with performance and other self-reported measures range from r = 0.64 to 0.84 for the AM-PAC mobility scale in patients recovering from a unilateral hip fracture with noncomplicated surgical repair[67]
- Individuals who used an assisted device reported significantly lower functioning than those who did not on the AM-PAC mobility and daily activity scales in patients recovering from a unilateral hip fracture with noncomplicated surgical repair[67]
- Basic mobility scores were moderately to strongly correlated with the 5TSS, stair climb, and TUG test (r = 0.44-0.62)[19]
- Daily activity scores were moderately to strongly correlated with the 5TSS, stair climb, and TUG test (r = 0.40-0.57)[19]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect size: at 12-week follow-up, the effect size for AM-PAC basic mobility was Cohen's d = 1.28 and for daily activities was d = 0.93 in patients recovering from a unilateral hip fracture with noncomplicated surgical repair[67]
- SRM: at 12-week follow-up, the SRM for AM-PAC basic mobility was 1.43 and for daily activities was 1.22 in patients recovering from a unilateral hip fracture with noncomplicated surgical repair[67]

How to Access

- AM-PAC short forms are copyrighted and can be licensed within different licensing products. To maintain instrument integrity, the instructions, items, and response options cannot be altered. The AM-PAC CAT (PC version) software, manual, and short forms are available at www.Pearsonassessments.com/AMPAC or www.am-pac.com

Recommended Future Research in Older Adults With Hip Fracture

- Reliability estimates
- MCID

Evidence Summary and Rationale

The AM-PAC has strong measurement properties in large cohorts of patients in postacute care, including those with hip fracture. Evidence specific to older adults is somewhat limited, and the proprietary nature of the instrument has affected the GDT's rec-

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ommendation. However, the conceptual framework and computer adaptive capability make it particularly attractive for detection of changes in status across the episode of care. Therefore, the recommendation is weak, based on level II evidence specific to older adults with hip fracture.

Recommendation

C Physical therapists may use the AM-PAC in all settings.

Medical Outcomes Study 36-Item Short-Form Health Survey

Construct Measured and ICF Level

Impairment/body structure and function and activity and participation.

Description and Discussion

The SF-36 measures health status in 8 dimensions and provides 2 summary measures: the physical component summary (PCS) and mental component summary (MCS). The PCS includes information from the physical functioning, role-physical, bodily pain, and general health subscales. Ten items addressing physical function are scored as the 10-item physical functioning scale (PF-10). The PF-10 focuses on limitations in activities because of health problems.

- Scoring: the SF-36 requires the use of a proprietary scoring algorithm. There are 8 domain scores, ranging from 0 to 100, where higher scores indicate better health. Two norm-based summary scores are calculated: physical (PCS) and mental (MCS), with a mean ± SD of 50 ± 10, where the mean for the reference population was 50. The sum of answers to the 10 physical function questions is used to calculate a score from 0 to 100, where higher scores indicate better physical functioning
- Time to administer: the entire SF-36 takes an average of 10 minutes to administer
- Equipment required: paper and pencil
- Training required and resources available: none
- Assistive devices: not specifically addressed

Measurement Properties

Reliability and Precision

For older adults with hip fracture:

- Poor test-retest reliability was found in older adults with hip fracture for the SF-36[20,34]

Validity

For older adults with hip fracture:

- Adults older than 50 years of age with a hip fracture had significantly lower component and subscale scores than a sex- and age-matched control group[33]
- For adults older than 50 years of age with a hip fracture, the SF-36 PCS demonstrated moderate correlations with a different self-report and a performance-based outcome measure[33]
- Correlation between the Osteoporosis Assessment Questionnaire[2] and the PF-10 was $r = 0.76$[87]
- Validity was rated as adequate, with moderate-quality evidence in a systematic review of patient-reported measures in older people with hip fracture[34]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Responsiveness was rated as adequate, with moderate-quality evidence in a systematic review of patient-reported measures in older people with hip fracture[34]
- Effect size: in older adults with a hip fracture, the effect size for the PF-10 was 1.3 at 6 weeks and 1.1 at 6 months[41]
- SRM: in older adults with hip fracture, the PF-10 SRM was 1.6 at 6 weeks and 0.7 at 6 months[41]
- SRM: responsiveness for the PF-10 at multiple comparison points in the first 6 months of recovery showed effect sizes ranging from 0.7 to 1.45 and SRMs ranging from 0.8 to 1.6[67]
- MCID: no estimates found in older adults with hip fracture

Floor/Ceiling Issues

- Both ceiling and floor effects of approximately 15% were reported for various subscales and were found at different time periods[95]

How to Access

- Requires a license
- Refer to website: http://www.rand.org/health/surveys_tools/mos/36-item-short-form.html

Recommended Future Research in Older Adults With Hip Fracture

- Test-retest reliability
- MCID

Evidence Summary and Rationale

Although the SF-36 is one of the most widely multidimensional health status instruments, the evidence in older adults with fracture is best described as level III. This has impacted the strength of the evidence and the strength of recommendation (weak) for the SF-36, including the PCS and PF-10.

Recommendations

C Physical therapists may use the SF-36 PF-10 in all settings.

C Physical therapists may use the SF-36 in all settings to measure health-related quality of life.

3-Level Version of the EuroQol-5 Dimensions Scale (EQ-5D-3L)

Construct Measured and ICF Level

Mobility, pain/discomfort, anxiety/depression, self-care, usual activity. ICF level: body structure, body function, and activity/participation.

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Description and Discussion

The EQ-5D-3L covers 5 domains of functioning, often described as health-related quality of life: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression. Respondents are asked to endorse the statements that best describe their current health in each domain on 3 levels (versus 5 levels). This provides the "profile" or health status classification. There are 2 ways the EQ-5D-3L can provide an overall score for quality of life: profile and VAS. This entry addresses the EQ-5D-3L profile.

- Scoring: respondents are asked to answer 1 question for each domain, and to endorse 1 of 3 options for each question: no problem, moderate problems, or severe problems. A country-specific algorithm can be applied to the respondent's profile that integrates societal utilities/preference values. This results in a score from 0 to 1, anchored at 0 for dead and 1 for best possible health. There are a range of algorithms, based on studies to estimate values from different populations
- Time to administer: less than 5 minutes
- Equipment required: paper and pencil. A scoring algorithm is required to convert profile score to overall score
- Training required and resources available: none
- Assistive devices: the instrument does not address assistive devices

Measurement Properties

Reliability and Precision

- No studies were identified in patients with hip fracture, and the scale was rated as inadequate in a systematic review of patient-reported measures in patients with hip fracture[34]

Validity

For older adults with hip fracture:

- Content coverage/validity was rated as inadequate[34]
- Strong correlations were reported with the Oxford Hip Score (r = 0.70-0.77) in a cohort of patients with hip fracture[83]
- Moderately strong predictor of death at 12 months following hip fracture. The estimated AUC for death was 0.72 in a cohort of patients with hip fracture[83]
- Validity was rated as adequate based on limited evidence in a systematic review[34]
- Strong correlations with Harris Hip Score at 4, 12, and 24 months after fracture (r = 0.75-0.79)[36]
- Moderate correlation with a quality-of-life measure focused on capability rather than functioning (ICEpop CAPability measure for Older people): r = 0.53 (95% CI: 0.33, 0.68)[74]
- Correlations varied between the EQ-5D-3L and the Cornell Scale for Depression in Dementia, modified Barthel index, and Pain Assessment in Advanced Dementia Scale for older adults in residential care after hip fracture. This sample included a large proportion of patients with moderate to severe cognitive impairment (84%)[88]
- Percent at the highest score (ceiling): 12% at 4 months, 20% at 12 months, and 23% at 24 months[36]

Sensitivity/Responsiveness/Score Interpretation: Effect Size, SRM, MCID

For older adults with hip fracture:

- Effect size, 0.68 to 0.64 in a cohort of patients with hip fracture[83]
- Effect size, 1.37 in elderly patients with a displaced femoral neck fracture[98]
- The EQ-5D-3L is sensitive to monitor health improvement after surgery for hip replacement in the first 4 weeks, and less so after this early period: Parsons et al[83] reported on 2 samples with hip fracture: effect size of 0.67 at 1-month follow-up, 0.32 at 3 months, and 0.27 at 1 year for 1 sample and 0.64 and 0.27 at 4 weeks and 4 months, respectively, for the second sample
- Effect size, 1.09 at 4 months, 0.82 at 12 months, and 0.72 at 24 months after fracture[36]
- SRM, 0.90 in older adults with a displaced femoral neck fracture[98]
- SRM, 1.0 at 4 months, 0.69 at 12 months, and 0.62 at 24 months after fracture[36]
- MCID, 0.05 using perceived health (excellent, very good, good, fair, poor)[36]

Floor/Ceiling Issues

- No evidence was found specific to older adults with hip fracture

How to Access

- The EQ-5D-3L can be accessed at https://euroqol.org/

Recommended Future Research in Older Adults With Hip Fracture

- Reliability estimates
- Effect size, SRM (in a larger range of hip fracture types), MCID

Evidence Summary and Rationale

Although the EQ-5D-3L is widely used to measure health-related quality of life, evidence specific to older adults with hip fracture remains limited, particularly for reliability. Therefore, the recommendation is weak, based on level III evidence.

Recommendation

C Physical therapists may use the EQ-5D-3L in all settings to measure health-related quality of life.

Abbreviations: 5TSS, 5-times sit-to-stand test; 6MWT, 6-minute walk test; ADL, activities of daily living; AM-PAC, Activity Measure for Post-Acute Care; AUC, area under the curve; CAS, Cumulated Ambulation Score; CAT, computer adaptive testing; CI, confidence interval; DEMMI, de Morton Mobility Index; EQ-5D, EuroQol-5 dimensions scale; EQ-5D-3L, 3-level version of the EuroQol-5 dimensions scale; FES-I, Falls Efficacy Scale-International; FIM, Functional Independence Measure; GDT, guideline development team; ICC, intraclass correlation coefficient; ICF, International Classification of Functioning, Disability and Health; MCID, minimal clinically important difference; MCS, mental component summary; MDC, minimum detectable change; NMS, New Mobility Score; NRS, numeric rating scale; OR, odds ratio; PCS, physical component summary; PF-10, 10-item physical functioning scale; RM, repetition maximum; SEM, standard error of measurement; SF-12, Medical Outcomes Study 12-Item Short-Form Health Survey; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; SPPB, Short Physical Performance Battery; SRM, standardized response mean; TUG, timed up and go; VAS, visual analog scale; VRS, verbal rating scale.

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REFERENCES

1. Alley DE, Hicks GE, Shardell M, et al. Meaningful improvement in gait speed in hip fracture recovery. *J Am Geriatr Soc*. 2011;59:1650-1657. https://doi.org/10.1111/j.1532-5415.2011.03560.x
2. American Thoracic Society Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med*. 2002;166:111-117. https://doi.org/10.1164/ajrccm.166.1.at1102
3. Andres PL, Haley SM, Ni PS. Is patient-reported function reliable for monitoring postacute outcomes? *Am J Phys Med Rehabil*. 2003;82:614-621. https://doi.org/10.1097/01.PHM.0000073818.34847.F0
4. Ariza-Vega P, Mora-Traverso M, Ortiz-Piña M, Ashe MC, Kristensen MT. Translation, inter-rater reliability, agreement, and internal consistency of the Spanish version of the Cumulated Ambulation Score in patients after hip fracture. *Disabil Rehabil*. 2020;42:2766-2771. https://doi.org/10.1080/09638288.2019.1577499
5. Auais MA, Eilayyan O, Mayo NE. Extended exercise rehabilitation after hip fracture improves patients' physical function: a systematic review and meta-analysis. *Phys Ther*. 2012;92:1437-1451. https://doi.org/10.2522/ptj.20110274
6. Avin KG, Hanke TA, Kirk-Sanchez N, et al. Management of falls in community-dwelling older adults: clinical guidance statement from the Academy of Geriatric Physical Therapy of the American Physical Therapy Association. *Phys Ther*. 2015;95:815-834. https://doi.org/10.2522/ptj.20140415
7. Bech RD, Lauritsen J, Ovesen O, Overgaard S. The verbal rating scale is reliable for assessment of postoperative pain in hip fracture patients. *Pain Res Treat*. 2015;2015:676212. https://doi.org/10.1155/2015/676212
8. Blackwell T, Cawthon PM, Marshall LM, Brand R. Consistency of leg extension power assessments in older men: the Osteoporotic Fractures in Men (MrOS) study. *Am J Phys Med Rehabil*. 2009;88:934-940. https://doi.org/10.1097/PHM.0b013e3181bbddfb
9. Bloch ML, Jønsson LR, Kristensen MT. Introducing a third Timed Up & Go trial improves performances of hospitalized and community-dwelling older individuals. *J Geriatr Phys Ther*. 2017;40:121-126. https://doi.org/10.1519/JPT.0000000000000080
10. Bohannon RW. Measuring knee extensor muscle strength. *Am J Phys Med Rehabil*. 2001;80:13-18. https://doi.org/10.1097/00002060-200101000-00004
11. Bohannon RW. Reference values for the five-repetition sit-to-stand test: a descriptive meta-analysis of data from elders. *Percept Mot Skills*. 2006;103:215-222. https://doi.org/10.2466/pms.103.1.215-222
12. Bohannon RW. Reference values for knee extension strength obtained by hand-held dynamometry from apparently healthy older adults: a meta-analysis. *J Frailty Aging*. 2017;6:199-201. https://doi.org/10.14283/jfa.2017.32
13. Butland RJ, Pang J, Gross ER, Woodcock AA, Geddes DM. Two-, six-, and 12-minute walking tests in respiratory disease. *Br Med J (Clin Res Ed)*. 1982;284:1607-1608. https://doi.org/10.1136/bmj.284.6329.1607
14. Coster WJ, Haley SM, Jette AM. Measuring patient-reported outcomes after discharge from inpatient rehabilitation settings. *J Rehabil Med*. 2006;38:237-242. https://doi.org/10.1080/16501970600609774
15. Csuka M, McCarty DJ. Simple method for measurement of lower extremity muscle strength. *Am J Med*. 1985;78:77-81. https://doi.org/10.1016/0002-9343(85)90465-6
16. de Morton NA, Davidson M, Keating JL. The de Morton Mobility Index (DEMMI): an essential health index for an ageing world. *Health Qual Life Outcomes*. 2008;6:63. https://doi.org/10.1186/1477-7525-6-63
17. de Morton NA, Harding KE, Taylor NF, Harrison G. Validity of the de Morton Mobility Index (DEMMI) for measuring the mobility of patients with hip fracture during rehabilitation. *Disabil Rehabil*. 2013;35:325-333. https://doi.org/10.3109/09638288.2012.705220
18. Dewhirst RC, Ellis DP, Mandara EA, Jette DU. Therapists' perceptions of application and implementation of AM-PAC "6-Clicks" functional measures in acute care: qualitative study. *Phys Ther*. 2016;96:1085-1092. https://doi.org/10.2522/ptj.20150009
19. Doll H, Gentile B, Bush EN, Ballinger R. Evaluation of the measurement properties of four performance outcome measures in patients with elective hip replacements, elective knee replacements, or hip fractures. *Value Health*. 2018;21:1104-1114. https://doi.org/10.1016/j.jval.2018.02.006
20. Duppils GS, Wikblad K. Cognitive function and health-related quality of life after delirium in connection with hip surgery: a six-month follow-up. *Orthop Nurs*. 2004;23:195-203. https://doi.org/10.1097/00006416-200405000-00009
21. Farag I, Sherrington C, Kamper SJ, et al. Measures of physical functioning after hip fracture: construct validity and responsiveness of performance-based and self-reported measures. *Age Ageing*. 2012;41:659-664. https://doi.org/10.1093/ageing/afs090
22. Ferriero G, Kristensen MT, Invernizzi M, et al. Psychometric properties of the Cumulated Ambulation Score: a systematic review. *Eur J Phys Rehabil Med*. 2018;54:766-771. https://doi.org/10.23736/S1973-9087.18.04822-0
23. Fitzgerald M, Blake C, Askin D, Quinlan J, Coughlan T, Cunningham C. Mobility one week after a hip fracture – can it be predicted? *Int J Orthop Trauma Nurs*. 2018;29:3-9. https://doi.org/10.1016/j.ijotn.2017.11.001
24. Foss NB, Kristensen MT, Kehlet H. Prediction of postoperative morbidity, mortality and rehabilitation in hip fracture patients: the cumulated ambulation score. *Clin Rehabil*. 2006;20:701-708. https://doi.org/10.1191/0269215506cre987oa
25. Foss NB, Kristensen MT, Palm H, Kehlet H. Postoperative pain after hip fracture is procedure specific. *Br J Anaesth*. 2009;102:111-116. https://doi.org/10.1093/bja/aen345
26. Freter SH, Fruchter N. Relationship between timed 'up and go' and gait time in an elderly orthopaedic rehabilitation population. *Clin Rehabil*. 2000;14:96-101. https://doi.org/10.1191/026921500675545616
27. Ganz SB, Peterson MG, Russo PW, Guccione A. Functional recovery after hip fracture in the subacute setting. *HSS J*. 2007;3:50-57. https://doi.org/10.1007/s11420-006-9022-3
28. Gherardini S, Biricolti C, Benvenuti E, et al. Prognostic implications of predischarge assessment of gait speed after hip fracture surgery. *J Geriatr Phys Ther*. 2019;42:148-152. https://doi.org/10.1519/JPT.0000000000000144
29. Grana E, Verzellotti S, Grassi FA, et al. Cross-cultural validation of the Italian version of the Cumulated Ambulation Score. *Int J Rehabil Res*. 2016;39:160-164. https://doi.org/10.1097/MRR.0000000000000165
30. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol*. 1994;49:M85-M94. https://doi.org/10.1093/geronj/49.2.m85
31. Haley SM, Andres PL, Coster WJ, Kosinski M, Ni P, Jette AM. Short-form activity measure for post-acute care. *Arch Phys Med Rehabil*. 2004;85:649-660. https://doi.org/10.1016/j.apmr.2003.08.098
32. Haley SM, Coster WJ, Andres PL, et al. Activity outcome measurement for postacute care. *Med Care*. 2004;42:I49-I61. https://doi.org/10.1097/01.mlr.0000103520.43902.6c
33. Hall SE, Williams JA, Senior JA, Goldswain PR, Criddle RA. Hip fracture outcomes: quality of life and functional status in older adults living in the community. *Aust N Z J Med*. 2000;30:327-332. https://doi.org/10.1111/j.1445-5994.2000.tb00833.x
34. Haywood KL, Brett J, Tutton E, Staniszewska S. Patient-reported outcome measures in older people with hip fracture: a systematic review of quality and acceptability. *Qual Life Res*. 2017;26:799-812. https://doi.org/10.1007/s11136-016-1424-1
35. Herrick C, Steger-May K, Sinacore DR, Brown M, Schechtman KB, Binder EF. Persistent pain in frail older adults after hip fracture repair. *J Am Geriatr Soc*. 2004;52:2062-2068. https://doi.org/10.1111/j.1532-5415.2004.52566.x
36. Honkavaara N, Al-Ani AN, Campenfeldt P, Ekström W, Hedström M. Good responsiveness with EuroQol 5-Dimension questionnaire and Short Form (36) Health Survey in 20–69 years old patients with a femoral neck fracture: a 2-year prospective follow-up study in 182 patients. *Injury*. 2016;47:1692-1697. https://doi.org/10.1016/j.injury.2016.05.021
37. Hulsbaek S, Larsen RF, Rosthøj S, Kristensen MT. The Barthel Index and the Cumulated Ambulation Score are superior to the de Morton Mobility Index for the early assessment of outcome in patients with a hip fracture admitted to an acute geriatric ward. *Disabil Rehabil*. 2019;41:1351-1359. https://doi.org/10.1080/09638288.2018.1424951

APPENDIX I

38. Hulsbaek S, Larsen RF, Troelsen A. Predictors of not regaining basic mobility after hip fracture surgery. *Disabil Rehabil*. 2015;37:1739-1744. https://doi.org/10.3109/09638288.2014.974836
39. Ingemarsson AH, Frändin K, Hellström K, Rundgren Å. Balance function and fall-related efficacy in patients with newly operated hip fracture. *Clin Rehabil*. 2000;14:497-505. https://doi.org/10.1191/0269215500cr352oa
40. Ingemarsson AH, Frändin K, Mellstrom D, Möller M. Walking ability and activity level after hip fracture in the elderly - a follow-up. *J Rehabil Med*. 2003;35:76-83. https://doi.org/10.1080/16501970306113
41. Jaglal S, Lakhani Z, Schatzker J. Reliability, validity, and responsiveness of the lower extremity measure for patients with a hip fracture. *J Bone Joint Surg Am*. 2000;82-A:955-962. https://doi.org/10.2106/00004623-200007000-00007
42. Jellesmark A, Herling SF, Egerod I, Beyer N. Fear of falling and changed functional ability following hip fracture among community-dwelling elderly people: an explanatory sequential mixed method study. *Disabil Rehabil*. 2012;34:2124-2131. https://doi.org/10.3109/09638288.2012.673685
43. Jette AM, Haley SM, Tao W, et al. Prospective evaluation of the AM-PAC-CAT in outpatient rehabilitation settings. *Phys Ther*. 2007;87:385-398. https://doi.org/10.2522/ptj.20060121
44. Jette DU, Stilphen M, Ranganathan VK, Passek S, Frost FS, Jette AM. Interrater reliability of AM-PAC "6-Clicks" basic mobility and daily activity short forms. *Phys Ther*. 2015;95:758-766. https://doi.org/10.2522/ptj.20140174
45. Jette DU, Stilphen M, Ranganathan VK, Passek SD, Frost FS, Jette AM. AM-PAC "6-Clicks" functional assessment scores predict acute care hospital discharge destination. *Phys Ther*. 2014;94:1252-1261. https://doi.org/10.2522/ptj.20130359
46. Jette DU, Stilphen M, Ranganathan VK, Passek SD, Frost FS, Jette AM. Validity of the AM-PAC "6-Clicks" inpatient daily activity and basic mobility short forms. *Phys Ther*. 2014;94:379-391. https://doi.org/10.2522/ptj.20130199
47. Jones CA, Feeny DH. Agreement between patient and proxy responses during recovery after hip fracture: evidence for the FIM instrument. *Arch Phys Med Rehabil*. 2006;87:1382-1387. https://doi.org/10.1016/j.apmr.2006.06.008
48. Jones CA, Jhangri GS, Feeny DH, Beaupre LA. Cognitive status at hospital admission: postoperative trajectory of functional recovery for hip fracture. *J Gerontol A Biol Sci Med Sci*. 2017;72:61-67. https://doi.org/10.1093/gerona/glv138
49. Kammerlander C, Gosch M, Kammerlander-Knauer U, Luger TJ, Blauth M, Roth T. Long-term functional outcome in geriatric hip fracture patients. *Arch Orthop Trauma Surg*. 2011;131:1435-1444. https://doi.org/10.1007/s00402-011-1313-6
50. Katoh M, Kaneko Y. An investigation into reliability of knee extension muscle strength measurements, and into the relationship between muscle strength and means of independent mobility in the ward: examinations of patients who underwent femoral neck fracture surgery. *J Phys Ther Sci*. 2014;26:15-19. https://doi.org/10.1589/jpts.26.15
51. Kempen GI, Yardley L, van Haastregt JC, et al. The Short FES-I: a shortened version of the Falls Efficacy Scale-International to assess fear of falling. *Age Ageing*. 2008;37:45-50. https://doi.org/10.1093/ageing/afm157
52. Kristensen MT. Hip fracture–related pain strongly influences functional performance of patients with an intertrochanteric fracture upon discharge from the hospital. *PM R*. 2013;5:135-141. https://doi.org/10.1016/j.pmrj.2012.10.006
53. Kristensen MT, Andersen L, Bech-Jensen R, et al. High intertester reliability of the Cumulated Ambulation Score for the evaluation of basic mobility in patients with hip fracture. *Clin Rehabil*. 2009;23:1116-1123. https://doi.org/10.1177/0269215509342330
54. Kristensen MT, Bandholm T, Bencke J, Ekdahl C, Kehlet H. Knee-extension strength, postural control and function are related to fracture type and thigh edema in patients with hip fracture. *Clin Biomech (Bristol, Avon)*. 2009;24:218-224. https://doi.org/10.1016/j.clinbiomech.2008.10.003
55. Kristensen MT, Bandholm T, Foss NB, Ekdahl C, Kehlet H. High inter-tester reliability of the New Mobility Score in patients with hip fracture. *J Rehabil Med*. 2008;40:589-591. https://doi.org/10.2340/16501977-0217
56. Kristensen MT, Bandholm T, Holm B, Ekdahl C, Kehlet H. Timed Up & Go test score in patients with hip fracture is related to the type of walking aid. *Arch Phys Med Rehabil*. 2009;90:1760-1765. https://doi.org/10.1016/j.apmr.2009.05.013
57. Kristensen MT, Ekdahl C, Kehlet H, Bandholm T. How many trials are needed to achieve performance stability of the Timed Up & Go test in patients with hip fracture? *Arch Phys Med Rehabil*. 2010;91:885-889. https://doi.org/10.1016/j.apmr.2010.01.021
58. Kristensen MT, Foss NB, Ekdahl C, Kehlet H. Prefracture functional level evaluated by the New Mobility Score predicts in-hospital outcome after hip fracture surgery. *Acta Orthop*. 2010;81:296-302. https://doi.org/10.3109/17453674.2010.487240
59. Kristensen MT, Foss NB, Kehlet H. Factors with independent influence on the 'timed up and go' test in patients with hip fracture. *Physiother Res Int*. 2009;14:30-41. https://doi.org/10.1002/pri.414
60. Kristensen MT, Foss NB, Kehlet H. Timed "Up & Go" Test as a predictor of falls within 6 months after hip fracture surgery. *Phys Ther*. 2007;87:24-30. https://doi.org/10.2522/ptj.20050271
61. Kristensen MT, Henriksen S, Stie SB, Bandholm T. Relative and absolute intertester reliability of the Timed Up and Go Test to quantify functional mobility in patients with hip fracture. *J Am Geriatr Soc*. 2011;59:565-567. https://doi.org/10.1111/j.1532-5415.2010.03293.x
62. Kristensen MT, Kehlet H. The basic mobility status upon acute hospital discharge is an independent risk factor for mortality up to 5 years after hip fracture surgery. *Acta Orthop*. 2018;89:47-52. https://doi.org/10.1080/17453674.2017.1382038
63. Kristensen MT, Kehlet H. Most patients regain prefracture basic mobility after hip fracture surgery in a fast-track programme. *Dan Med J*. 2012;59:A4447.
64. Kristensen MT, Öztürk B, Röck ND, Ingeman A, Palm H, Pedersen AB. Regaining pre-fracture basic mobility status after hip fracture and association with post-discharge mortality and readmission—a nationwide register study in Denmark. *Age Ageing*. 2019;48:278-284. https://doi.org/10.1093/ageing/afy185
65. Kronborg L, Bandholm T, Palm H, Kehlet H, Kristensen MT. Feasibility of progressive strength training implemented in the acute ward after hip fracture surgery. *PLoS One*. 2014;9:e93332. https://doi.org/10.1371/journal.pone.0093332
66. Laflamme GY, Rouleau DM, Leduc S, Roy L, Beaumont E. The Timed Up and Go test is an early predictor of functional outcome after hemiarthroplasty for femoral neck fracture. *J Bone Joint Surg Am*. 2012;94:1175-1179. https://doi.org/10.2106/JBJS.J.01952
67. Latham NK, Mehta V, Nguyen AM, et al. Performance-based or self-report measures of physical function: which should be used in clinical trials of hip fracture patients? *Arch Phys Med Rehabil*. 2008;89:2146-2155. https://doi.org/10.1016/j.apmr.2008.04.016
68. Lee SY, Yoon BH, Beom J, Ha YC, Lim JY. Effect of lower-limb progressive resistance exercise after hip fracture surgery: a systematic review and meta-analysis of randomized controlled studies. *J Am Med Dir Assoc*. 2017;18:1096.e19-1096.e26. https://doi.org/10.1016/j.jamda.2017.08.021
69. Leino KA, Kuusniemi KS, Lertola KK, Olkkola KT. Comparison of four pain scales in patients with hip fracture or other lower limb trauma. *Acta Anaesthesiol Scand*. 2011;55:495-502. https://doi.org/10.1111/j.1399-6576.2010.02373.x
70. Lin YC, Davey RC, Cochrane T. Tests for physical function of the elderly with knee and hip osteoarthritis. *Scand J Med Sci Sports*. 2001;11:280-286. https://doi.org/10.1034/j.1600-0838.2001.110505.x
71. Lusardi MM, Fritz S, Middleton A, et al. Determining risk of falls in community dwelling older adults: a systematic review and meta-analysis using posttest probability. *J Geriatr Phys Ther*. 2017;40:1-36. https://doi.org/10.1519/JPT.0000000000000099
72. Mangione KK, Craik RL, Palombaro KM, Tomlinson SS, Hofmann MT. Home-based leg-strengthening exercise improves function 1 year after hip fracture: a randomized controlled study. *J Am Geriatr Soc*. 2010;58:1911-1917. https://doi.org/10.1111/j.1532-5415.2010.03076.x
73. Mendelsohn ME, Leidl DS, Overend TJ, Petrella RJ. Specificity of functional mobility measures in older adults after hip fracture: a pilot study. *Am J Phys Med Rehabil*. 2003;82:766-774. https://doi.org/10.1097/00002060-200310000-00005
74. Milte R, Crotty M, Miller MD, Whitehead C, Ratcliffe J. Quality of life in older adults following a hip fracture: an empirical comparison of the ICECAP-O and the EQ-5D-3 L instruments. *Health Qual Life Outcomes*. 2018;16:173. https://doi.org/10.1186/s12955-018-1005-9

APPENDIX I

75. Mitchell SL, Stott DJ, Martin BJ, Grant SJ. Randomized controlled trial of quadriceps training after proximal femoral fracture. *Clin Rehabil*. 2001;15:282-290. https://doi.org/10.1191/026921501676849095

76. Moore JL, Potter K, Blankshain K, Kaplan SL, O'Dwyer LC, Sullivan JE. A core set of outcome measures for adults with neurologic conditions undergoing rehabilitation: a clinical practice guideline. *J Neurol Phys Ther*. 2018;42:174-220. https://doi.org/10.1097/NPT.0000000000000229

77. Nygard H, Matre K, Fevang JM. Evaluation of Timed Up and Go Test as a tool to measure postoperative function and prediction of one year walking ability for patients with hip fracture. *Clin Rehabil*. 2016;30:472-480. https://doi.org/10.1177/0269215515591039

78. Overgaard J, Kristensen MT. Feasibility of progressive strength training shortly after hip fracture surgery. *World J Orthop*. 2013;4:248-258. https://doi.org/10.5312/wjo.v4.i4.248

79. Overgaard JA, Larsen CM, Holtze S, Ockholm K, Kristensen MT. Interrater reliability of the 6-minute walk test in women with hip fracture. *J Geriatr Phys Ther*. 2017;40:158-166. https://doi.org/10.1519/JPT.0000000000000088

80. Palombaro KM, Craik RL, Mangione KK, Tomlinson JD. Determining meaningful changes in gait speed after hip fracture. *Phys Ther*. 2006;86:809-816. https://doi.org/10.1093/ptj/86.6.809

81. Parker MJ, Palmer CR. A new mobility score for predicting mortality after hip fracture. *J Bone Joint Surg Br*. 1993;75:797-798. https://doi.org/10.1302/0301-620X.75B5.8376443

82. Parker MJ, Palmer CR. Prediction of rehabilitation after hip fracture. *Age Ageing*. 1995;24:96-98. https://doi.org/10.1093/ageing/24.2.96

83. Parsons N, Griffin XL, Achten J, Costa ML. Outcome assessment after hip fracture: is EQ-5D the answer? *Bone Joint Res*. 2014;3:69-75. https://doi.org/10.1302/2046-3758.33.2000250

84. Pedersen TJ, Lauritsen JM. Routine functional assessment for hip fracture patients. *Acta Orthop*. 2016;87:374-379. https://doi.org/10.1080/17453674.2016.1197534

85. Piscitelli P, Metozzi A, Benvenuti E, et al. Connections between the outcomes of osteoporotic hip fractures and depression, delirium or dementia in elderly patients: rationale and preliminary data from the CODE study. *Clin Cases Miner Bone Metab*. 2012;9:40-44.

86. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc*. 1991;39:142-148. https://doi.org/10.1111/j.1532-5415.1991.tb01616.x

87. Randell AG, Nguyen TV, Bhalerao N, Silverman SL, Sambrook PN, Eisman JA. Deterioration in quality of life following hip fracture: a prospective study. *Osteoporos Int*. 2000;11:460-466. https://doi.org/10.1007/s001980070115

88. Ratcliffe J, Flint T, Easton T, et al. An empirical comparison of the EQ-5D-5L, DEMQOL-U and DEMQOL-Proxy-U in a post-hospitalisation population of frail older people living in residential aged care. *Appl Health Econ Health Policy*. 2017;15:399-412. https://doi.org/10.1007/s40258-016-0293-7

89. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *J Aging Phys Act*. 1999;7:129-161. https://doi.org/10.1123/japa.7.2.129

90. Rikli RE, Jones CJ. Functional fitness normative scores for community-residing older adults, ages 60-94. *J Aging Phys Act*. 1998;7:162-181. https://doi.org/10.1123/japa.7.2.162

91. Schwenk M, Schmidt M, Pfisterer M, Oster P, Hauer K. Rollator use adversely impacts on assessment of gait and mobility during geriatric rehabilitation. *J Rehabil Med*. 2011;43:424-429. https://doi.org/10.2340/16501977-0791

92. Sherrington C, Lord SR. Reliability of simple portable tests of physical performance in older people after hip fracture. *Clin Rehabil*. 2005;19:496-504. https://doi.org/10.1191/0269215505cr833oa

93. Sherrington C, Lord SR, Herbert RD. A randomised trial of weight-bearing versus non-weight-bearing exercise for improving physical ability in inpatients after hip fracture. *Aust J Physiother*. 2003;49:15-22. https://doi.org/10.1016/s0004-9514(14)60184-7

94. Shigemoto K, Sawaguchi T, Goshima K, Iwai S, Nakanishi A, Ueoka K. The effect of a multidisciplinary approach on geriatric hip fractures in Japan. *J Orthop Sci*. 2019;24:280-285. https://doi.org/10.1016/j.jos.2018.09.012

95. Shyu YI, Lu JF, Liang J. Evaluation of Medical Outcomes Study Short Form-36 Taiwan version in assessing elderly patients with hip fracture. *Osteoporos Int*. 2004;15:575-582. https://doi.org/10.1007/s00198-003-1580-3

96. Southard V, Gallagher R. The 6MWT: will different methods of instruction and measurement affect performance of healthy aging and older adults? *J Geriatr Phys Ther*. 2013;36:68-73. https://doi.org/10.1519/JPT.0b013e318264b5e8

97. Sylliaas H, Brovold T, Wyller TB, Bergland A. Prolonged strength training in older patients after hip fracture: a randomised controlled trial. *Age Ageing*. 2012;41:206-212. https://doi.org/10.1093/ageing/afr164

98. Tidermark J, Bergström G, Svensson O, Törnkvist H, Ponzer S. Responsiveness of the EuroQol (EQ 5-D) and the SF-36 in elderly patients with displaced femoral neck fractures. *Qual Life Res*. 2003;12:1069-1079. https://doi.org/10.1023/a:1026193812514

99. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. *J Gerontol*. 1990;45:P239-P243. https://doi.org/10.1093/geronj/45.6.p239

100. Visschedijk JH, Terwee CB, Caljouw MA, Spruit-van Eijk M, van Balen R, Achterberg WP. Reliability and validity of the Falls Efficacy Scale-International after hip fracture in patients aged ≥65 years. *Disabil Rehabil*. 2015;37:2225-2232. https://doi.org/10.3109/09638288.2014.1002573

101. Vukomanović A, Đurović A, Popović Z, Pejović V. The A-test: assessment of functional recovery during early rehabilitation of patients in an orthopedic ward - content, criterion and construct validity. *Vojnosanit Pregl*. 2014;71:715-722. https://doi.org/10.2298/vsp130118038v

102. Young Y, Fan MY, Hebel JR, Boult C. Concurrent validity of administering the Functional Independence Measure (FIM) instrument by interview. *Am J Phys Med Rehabil*. 2009;88:766-770. https://doi.org/10.1097/PHM.0b013e3181a9f1d6

APPENDIX J

CHARACTERISTICS OF STUDIES INCLUDED IN THE SYSTEMATIC REVIEWS BY DIONG ET AL[4] AND AUAIS ET AL[1]

High-Intensity Lower-Body Progressive Resistance Training

Study	Time Since Fracture or Surgery	Warm-up Time, Exercises	Session n or Length, Frequency, Duration	Exercises	Intensity	Sets, n
Binder et al[2] Phase 1: group (balance and flexibility)	Within 16 wk of hip fracture repair/time of discharge from physical therapy	5-15 min Stationary bike or treadmill	36 3 times per week 45-90 min	22 exercises focused on flexibility, balance, coordination, movement speed, and strength of all major muscle groups. Exercises were modified based on each patient's specific impairments	Increased difficulty by increasing repetitions or performing exercises in more challenging ways	Varied, based on participant's ability and safety
Binder et al[2] Phase 2: individual	Started 3 mo after start of phase 1 (see above)	NR Shortened version of phase 1 exercises and stationary bike or treadmill	36 3 times per week NR	Knee extension, knee flexion, seated bench press, seated row, leg press, biceps curl (performed bilaterally on a weightlifting machine)	65% of the patient's 1-RM, progressed to 85%-100% of initial 1-RM	1-2 sets of 6-8 repetitions, progressed to 3 sets of 8-12
Hauer et al[5]	6-8 wk after hip surgery	10 min Stationary bike, minimal workload (<25 W)	36 3 times per week 1.5 h	1. Knee and hip extensions on a leg press, sitting position 2. Hip abduction and extension, standing position, using a cable pulley 3. Ankle plantar flexion: heel raises with forefeet on a 2-cm support, progressing to 4 cm; some progressed to unilateral plantar flexion	Began with minimal resistance, then 70%-90% of individual maximal workload	1. 3 sets of 10 on the left and 10 on the right 2. 2 sets of 10 on the left and 10 on the right 3. 2 sets of 15
Mangione et al[7]	Average time since fracture was 3-5 mo across all groups	None None	20 Phase 1: 2 times per week for 2 mo; phase 2: once per week for 1 mo 30-40 min	Plantar flexors (unilateral or bilateral), hip and knee extensions (from supine position), hip abductions (supine), hip extensors, unilateral or bilateral heel raises. Used a portable progressive resistance exercise machine and body weight	8-RM	3 sets of 8 repetitions
Mitchell et al[8]	Patients in the control group entered the study at a median of 16 d after proximal femoral fracture surgery (range, 13-20 d), compared with 15 d (range, 12-24 d) in the quadriceps training group	NR NR	6 wk 2 times per week NR	2 knee extension exercises, 6-9 s per repetition; knee angle from 90° to 0°, then from 10° to 0°	Weeks 1 and 2, 50% of 1-RM; weeks 3 and 4, 70% of re-established 1-RM; weeks 5 and 6, 80% of re-established 1-RM	3 sets of 12 repetitions, 2-min rest between sets
Sylliaas et al[17] ("progressive strength training")	Starting at 12 wk after fracture	10-15 min Stationary bike or treadmill	12 wk 2 times per week, plus home training once per week 45-60 min	Standing knee flexion, lunge (pass forward), sitting knee extension, leg extension Home training: standing knee flexion and lunge (pass forward)	First 3 wk, 70% of 1-RM; after first 3 wk, 80% of 1-RM	First 3 wk, 3 sets of 15 repetitions; every third week, the number of repetitions was reduced from 12 to 10, while maintaining at least 8 repetitions
Sylliaas et al[18] ("prolonged strength training")	24 wk since fracture; living at home	10-15 min Stationary bike or treadmill	12 Once per week, plus home training once per week 45-60 min	Standing knee flexion, lunge (pass forward), sitting knee extension, leg press	80% of 1-RM for knee flexion and lunge, done with load depending on patient's ability	3 sets of 10 repetitions

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APPENDIX J

Study	Time Since Fracture or Surgery	Warm-up Time, Exercises	Session n or Length, Frequency, Duration	Exercises	Intensity	Sets, n
Peterson et al[12]	Initiation of physical therapy began on the first postoperative day	NR NR	8 wk 2 times per week 60 min	Circuit training (8 exercises): free weights, step machine to hip flexors and knee extensors, isotonic hip abduction machine, isokinetic machine to quadriceps and hamstrings, upper-body ergometer, total gym machine, therapeutic ball for balance activities, stationary bicycle, plus balance and a gait training program	60% of 1-RM for hip flexors and knee extensors	NR
Portegijs et al[13]	Men and women with a femoral neck or trochanteric fracture within 6 mo to 7 y before baseline were invited to participate in the study	10-min session Sitting in a chair	12 wk 2 times per week 1-1.5 h	Power training: leg press, ankle plantar flexion Strength training: leg press, knee extension, and hip abduction and adduction Exercises (from week 8 onward, the leg-press strength exercise was performed only once a week)	Power training: leg press, 40%-50% of 1-RM; ankle plantar flexion, weighted vest with 0%-10% of baseline body weight Strength training: 60%-80% of 1-RM for the weaker leg and 50%-70% of 1-RM for the stronger leg	Power training: leg press, 3-4 sets for the weaker leg and 2-3 sets for the stronger leg; ankle plantar flexion, both legs in 2-3 sets Strength training: weaker leg, 2-3 sets of 8 repetitions; stronger leg, 1-2 sets of 10 repetitions
Singh et al[16]	NR	NR NR	12 mo (average, 80 supervised exercise training sessions, 10 home visits, 10 phone calls) 2 times per week NR	Leg press, standing hip extension and abduction, knee extension, knee flexion, triceps, chest press, seated row	80% of most recent 1-RM (conducted monthly) or perceived exertion rating less than 15	3 sets of 8 repetitions

Abbreviations: NR, not reported; RM, repetition maximum.

Weight-Bearing Exercise

Study	Time Since Fracture or Surgery	Warm-up Time, Exercises	Session n or Length, Frequency, Duration	Exercises	Intensity	Sets, n
Oldmeadow et al[10]	Within 4 d of surgery	NR NR	7 d Once per day NR	Walking: early ambulators, day 1 or 2 Delayed ambulators, day 3 or 4	NR	Once per day
Sherrington and Lord[14]	Subjects were recruited an average of 7 mo after a fall-related hip fracture	NR NR	1 mo Once per day NR	NR (testing: "subjects placed one foot on a block and attempted to lift the contralateral leg off the ground by extending the hip and knee of the leg on the block. The ability to perform this exercise was assessed for each leg using both a 5.5-cm and a 10.5-cm block")	NR	Initially 5-50 repetitions, depending on the patient; increased gradually from there
Sherrington et al[15]	82% lived in the community; the remainder lived in low- or high-care residential aged-care facilities	NR NR	4 mo Once per day NR	Sit-to-stand, lateral step-up, forward step-up-and-over, forward foot taps, stepping grid	Increased number of repetitions, decreased support (walking frame or tables), increasing height of blocks, decreasing height of the surface patients were standing up from	Based on patient's ability

Abbreviation: NR, not reported.

APPENDIX J

Balance Training

Study	Time From Post Fracture to Start of Intervention	Warm-up Time, Exercises	Session n or Length, Frequency, Duration	Exercises	Intensity	Sets, n
Binder et al[2]	Surgery no more than 16 wk prior and had completed standard physical therapy	NR NR	72 (36 were balance) 3 times per week 45-90 min	Walking, stepping, sitting, throwing, catching, games, dance, tai chi	Complexity and difficulty increased to 65%-100% of 1-RM	3 sets of 8-12 repetitions
Bischoff-Ferrari et al[3]	NR	NR NR	During length of acute-care stay Once per day during acute-care stay 60 min in acute care; 30 min at home	Standing on both legs, standing on 1 leg while holding a hand rail, pulling a rubber band while sitting, getting in and out of a chair, and going up and down stairs	NR	NR
Latham et al[6]	Discharged from rehabilitation services within 20 mo of the baseline assessment	Noted to have a warm-up Noted to have a warm-up	6 mo 3 times per week NR	Functional tasks using resistance bands for resistance, standing exercises using steps of varying height: hip extension, heel raises onto toes, resisted rowing, standing diagonal reach, modified get-up-and-go, overhead arm extension, repeated chair stands, lunges (forward and back), stepping up and down on the step, calf raises (both legs and 1 leg)	Used weighted vests to increase intensity of standing exercises	NR
Moseley et al[9] ("high-dose" and "low-dose" weight-bearing exercise)	Included patients who represented the middle of the range of people with hip fracture High-functioning patients who were discharged directly to home and low-functioning patients who were discharged to a residential aged-care facility from the acute orthopaedic ward were excluded	NR NR	High dose, 16 wk; low dose, 4 wk High dose, 2 times per d; low dose, NR High dose, total of 60 min; low dose, total of 30 min	High dose: stepping in different directions, standing up and sitting down, tapping the foot and stepping onto and off a block, walking on a treadmill with partial body-weight support using a harness (for inpatients) or a walking program (after hospital discharge) Low dose: 5 exercises in sitting or lying, plus a small amount of walking using parallel bars or walking aids	High dose: progressed by reducing support from the hands, increasing block height, decreasing chair height, and increasing the number of repetitions Low dose: progressed by increasing the number of repetitions and resistance	NR
Orwig et al[11]	Community-dwelling patients within 15 d of fracture	20- to 30-min warm-up and cool-down periods NR	NR Aerobic activity 3 times per week, strength 2 times per week 30 min	The Exercise Plus Program: combined aerobic exercise using a stairstep with a comprehensive strengthening program (11 exercises for the upper and lower extremities, using resistance bands and/or ankle and wrist cuff weights) and a stretching program	Each participant started at her own individual level with regard to time spent in aerobic activities and the amount of repetitions and resistance used in the strengthening program, but was advanced to a higher level according to a standard protocol	3 sets of 10 repetitions
Peterson et al[12]	Initiation of physical therapy began on the first postoperative day	NR NR	8 wk 2 times per week 60 min	Circuit training (8 exercises): free weights, step machine to hip flexors and knee extensors, isotonic hip abduction machine, isokinetic machine to quadriceps and hamstrings, upper-body ergometer, total gym machine, therapeutic ball for balance activities, stationary bicycle, plus balance and a gait training program	60% of 1-RM for hip flexors and knee extensors	NR

Table continues on page CPG81.

APPENDIX J

Study	Time From Post Fracture to Start of Intervention	Warm-up Time, Exercises	Session n or Length, Frequency, Duration	Exercises	Intensity	Sets, n
Tsauo et al[19]	Recently discharged from an acute orthopaedic department	NR NR	NR NR NR	Strengthening exercises mainly for hip flexors, extensors, abductors, and knee extensors; range-of-motion exercises mainly for the hip joint; balance training; functional training such as sit-to-stand training, ambulation training, and stair climbing, if needed, in the home environment; practice of safe and efficient transfer techniques	Up to 1-kg sandbags	3 sets of 10 repetitions

Abbreviations: NR, not reported; RM, repetition maximum.

REFERENCES

1. Auais MA, Eilayyan O, Mayo NE. Extended exercise rehabilitation after hip fracture improves patients' physical function: a systematic review and meta-analysis. *Phys Ther*. 2012;92:1437-1451. https://doi.org/10.2522/ptj.20110274
2. Binder EF, Brown M, Sinacore DR, Steger-May K, Yarasheski KE, Schechtman KB. Effects of extended outpatient rehabilitation after hip fracture: a randomized controlled trial. *JAMA*. 2004;292:837-846. https://doi.org/10.1001/jama.292.7.837
3. Bischoff-Ferrari HA, Dawson-Hughes B, Platz A, et al. Effect of high-dosage cholecalciferol and extended physiotherapy on complications after hip fracture: a randomized controlled trial. *Arch Intern Med*. 2010;170:813-820. https://doi.org/10.1001/archinternmed.2010.67
4. Diong J, Allen N, Sherrington C. Structured exercise improves mobility after hip fracture: a meta-analysis with meta-regression. *Br J Sports Med*. 2016;50:346-355. https://doi.org/10.1136/bjsports-2014-094465
5. Hauer K, Specht N, Schuler M, Bärtsch P, Oster P. Intensive physical training in geriatric patients after severe falls and hip surgery. *Age Ageing*. 2002;31:49-57. https://doi.org/10.1093/ageing/31.1.49
6. Latham NK, Harris BA, Bean JF, et al. Effect of a home-based exercise program on functional recovery following rehabilitation after hip fracture: a randomized clinical trial. *JAMA*. 2014;311:700-708. https://doi.org/10.1001/jama.2014.469
7. Mangione KK, Craik RL, Tomlinson SS, Palombaro KM. Can elderly patients who have had a hip fracture perform moderate- to high-intensity exercise at home? *Phys Ther*. 2005;85:727-739. https://doi.org/10.1093/ptj/85.8.727
8. Mitchell SL, Stott DJ, Martin BJ, Grant SJ. Randomized controlled trial of quadriceps training after proximal femoral fracture. *Clin Rehabil*. 2001;15:282-290. https://doi.org/10.1191/026921501676849095
9. Moseley AM, Sherrington C, Lord SR, Barraclough E, St George RJ, Cameron ID. Mobility training after hip fracture: a randomised controlled trial. *Age Ageing*. 2009;38:74-80. https://doi.org/10.1093/ageing/afn217
10. Oldmeadow LB, Edwards ER, Kimmel LA, Kipen E, Robertson VJ, Bailey MJ. No rest for the wounded: early ambulation after hip surgery accelerates recovery. *ANZ J Surg*. 2006;76:607-611. https://doi.org/10.1111/j.1445-2197.2006.03786.x
11. Orwig DL, Hochberg M, Yu-Yahiro J, et al. Delivery and outcomes of a yearlong home exercise program after hip fracture: a randomized controlled trial. *Arch Intern Med*. 2011;171:323-331. https://doi.org/10.1001/archinternmed.2011.15
12. Peterson MGE, Ganz SB, Allegrante JP, Cornell CN. High-intensity exercise training following hip fracture. *Top Geriatr Rehabil*. 2004;20:273-284.
13. Portegijs E, Kallinen M, Rantanen T, et al. Effects of resistance training on lower-extremity impairments in older people with hip fracture. *Arch Phys Med Rehabil*. 2008;89:1667-1674. https://doi.org/10.1016/j.apmr.2008.01.026
14. Sherrington C, Lord SR. Home exercise to improve strength and walking velocity after hip fracture: a randomized controlled trial. *Arch Phys Med Rehabil*. 1997;78:208-212. https://doi.org/10.1016/s0003-9993(97)90265-3
15. Sherrington C, Lord SR, Herbert RD. A randomized controlled trial of weight-bearing versus non-weight-bearing exercise for improving physical ability after usual care for hip fracture. *Arch Phys Med Rehabil*. 2004;85:710-716. https://doi.org/10.1016/s0003-9993(03)00620-8
16. Singh NA, Quine S, Clemson LM, et al. Effects of high-intensity progressive resistance training and targeted multidisciplinary treatment of frailty on mortality and nursing home admissions after hip fracture: a randomized controlled trial. *J Am Med Dir Assoc*. 2012;13:24-30. https://doi.org/10.1016/j.jamda.2011.08.005
17. Sylliaas H, Brovold T, Wyller TB, Bergland A. Progressive strength training in older patients after hip fracture: a randomised controlled trial. *Age Ageing*. 2011;40:221-227. https://doi.org/10.1093/ageing/afq167
18. Sylliaas H, Brovold T, Wyller TB, Bergland A. Prolonged strength training in older patients after hip fracture: a randomised controlled trial. *Age Ageing*. 2012;41:206-212. https://doi.org/10.1093/ageing/afr164
19. Tsauo JY, Leu WS, Chen YT, Yang RS. Effects on function and quality of life of postoperative home-based physical therapy for patients with hip fracture. *Arch Phys Med Rehabil*. 2005;86:1953-1957. https://doi.org/10.1016/j.apmr.2005.04.020