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Review Article

A Critical Review of Literature Regarding the Effectiveness of Physical Therapy Management of Hip Fracture in Elderly Persons

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The purpose of this review is to analyze the research literature that has examined the effectiveness of physical therapy in the management of hip fractures in elderly persons. Using literature databases and keywords, we located relevant studies. Fifteen studies met the criteria and were then categorized according to Sackett's levels of evidence. Six studies were graded at level I, six at level II, and three at level V, with level I having the highest level of evidence. From the levels of evidence, one grade A, three grade B, and two grade C recommendations were developed, with grade A being the most significant recommendation. Clinical recommendations are offered about patients with dementia, therapeutic exercise, and when and for how long rehabilitation should continue. In addition, future research directions are provided.

INDIVIDUALS who sustain hip fractures exhibit high mortality and often demonstrate permanent disability and dependency despite successful surgical repair (1). Hip fractures occur most commonly in elderly females (90% 65 or older and 75% female) (2). In the United States, approximately 340,000 hip fractures occur yearly and, by 2040, an estimated 500,000 hip fractures will occur yearly (3). A mere 2% of all hip fractures occur in young athletes. Stress fractures tend to occur more in endurance sports such as swimming and running whereas hip fractures occur in contact sports such as football or soccer (3).

Hip fractures are classified as intracapsular (femoral head and neck) or extracapsular (trochanteric, intertrochanteric, and subtrochanteric). Stress fractures occur most frequently in the femoral neck and in normal bone undergoing repeated submaximal stress. As the bone attempts to remodel, osteoclastic activity occurs at a greater rate than osteoblastic activity. When these cumulative forces exceed the structural strength of bone, stress fractures occur (3). The mechanism of injury is usually due to a fall on a fragile skeleton, often when rising from a sitting to a standing position or vice versa (4).

There are some classic signs and symptoms of a hip fracture. Usually the individuals are unable to ambulate or stand on the injured leg (4). They have extreme pain with passive range of motion, limited range of motion (especially internal rotation), an antalgic gait pattern, and tenderness and swelling over the femoral neck. In addition, the heel percussion test and a tuning fork placed over the hip produce pain, and the affected leg may be externally rotated and shortened (3).

Treatment following hip fracture is multidisciplinary. First, the fracture must be treated surgically to stabilize the displaced bone, either a closed or open reduction and internal fixation (3). Following surgery, compression garments are used to prevent deep vein thrombosis (5). Vitamin D may be given supplemental to calcium to increase bone density and reduce falls (6). Affecting function more than any other lower extremity impairment, physical therapy plays an integral part in hip fracture healing; however, the most suitable intervention is controversial (2). The purpose of this article is to combine relevant research regarding the most appropriate physical therapy intervention for the treatment of hip fractures.

METHODS

There were several literature databases used, including PubMed (7), ProQuest (8), and EBSCO (9). Included articles were written in English, peer-reviewed, with no date restriction. Some of the articles were not available online but were available in the Walsh University library archives. Keywords used in the search were ''hip fracture,'' ''physical therapy,'' ''femoral neck fracture,'' and ''rehabilitation.'' An effective method of finding articles came from browsing through the ''reference'' sections of appropriate research and using the ''related articles'' option from the PubMed database (7). To be included in this review, the studies met the following requirements: physical therapy management, elderly persons (over the age of 60), and hip fracture surgically treated. Excluded from this review were fellow review articles.

The critical evaluation of the articles followed the same format as the Megens and Harris article regarding the validity of lymphedema (10). Sackett's five hierarchical levels of evidence and three grades of recommendations were also used as a reference in evaluating the studies and their scientific rigor (11). Megens and Harris also provided a fine description of the levels and grades (10).

Sackett's rules of evidence and grades of recommendations can be summarized as follows. Basically, there are five levels of evidence ranging from high certainty to decreasing certainty, level I to V, respectively. Level I is a large, randomized trial with low false-positive or false-negative errors. Level II is a small, randomized trial with high false-positives or low false-negative errors. Large trials included 100 or more participants. Level III is a nonrandomized, concurrent, cohort comparison between participants who did and did not receive intervention. Level IV is a nonrandomized, historical cohort comparison between participants who currently received intervention and past participants who had not received intervention. Level V is a case series of more than one individual without controls (10,11). The grades of recommendation were judged as follows: a grade A recommendation is supported by at least one level I study, a grade B recommendation is supported by at least one level II study, and a grade C recommendation is supported by levels III, IV, or V studies (10,11).

The scientific rigor of the studies was also evaluated using the following six criteria: 1) inclusion and exclusion criteria listed for the participants and an operational definition of the clinical problem provided; 2) treatment protocol adequately described to replicate; 3) reliability of data obtained with outcome measures assessed; 4) validity of outcome measures investigated; 5) assessors blinded to treatment groups; and 6) participants enrolled in study accounted for (10,11). Those labeled ''Y'' for ''yes'' fulfilled the specific criteria and those labeled ''N'' for ''no'' did not fulfill the criteria. If a study explicitly stated or referred to other studies that tested reliability and validity of outcome measures, it received a ''yes.''

Results

Initially, 34 articles were identified that referred to the physical therapy management of hip fracture in elderly persons. Excluded were review articles or studies regarding tests and measures. A total of 15 experimental articles were found. Each article was independently reviewed and classified according to Sackett's rules. Table 1 is a summary of the articles.

The studies varied in type of hip fracture, mechanism of injury, and research design. The location of the fracture was either the femoral neck (13), various places in the proximal femur (15,18,21,23), or unspecified (12,14,19,20). Some articles (14,23,25) explicitly stated that the fracture was due to a fall, whereas others (12,15,20,21) specified that the participant had been surgically treated prior to the study. Most articles were randomized, controlled experimental studies (13–17,19,20,23–26), although there were a few observational studies (21,22) and case studies (12,18).

The studies were critically evaluated. Six studies were categorized a level I (16,17,20,22,24,26); six studies were categorized a level II (13–15,19,23,25); and three studies were categorized a level V (12,18,21). The studies categorized a level I or II all included at least two groups with one group being a control group that did not receive intervention. The studies categorized level V were either case studies or observational studies. Therefore, according to these levels, Grade A recommendations were made involving the level I studies, Grade B recommendations were made involving the level II studies, and Grade C recommendations were made involving the level V studies.

There is conflicting evidence from three level I studies as to whether a multidisciplinary rehabilitation team improves the elderly patient's postsurgery status. One study states that multidisciplinary rehabilitation shows a significant benefit for the elderly patient (16), whereas two studies state that there is no difference (20,22). Two other level I studies also conflicted regarding weight-bearing home exercise programs. One stated that weight-bearing exercises showed improvement in balance and functional ability as opposed to nonweight-bearing exercises (24), whereas another resulted in both having equal effects (25). Despite these opposing outcomes, a few recommendations were made from the other studies.

Grade A Recommendation:

1. Patients with mild or moderate dementia will benefit from a multidisciplinary rehabilitation team to regain function (17).

Grade B Recommendations:

1. Treadmill gait training can be used to improve mobility outcomes (13).
2. A home-based rehabilitation program is as good as hospital rehabilitation for patients who had not lost many functional abilities prior to the hip fracture (14,19,26).
3. Elderly persons common suffer from detraining so a physical therapy program should be continued even after prefracture status has been attained (15).

Grade C Recommendations:

1. Physical therapy improves patient's prefracture ambulation status (12).
2. Therapy must be started sooner than 4 months after surgery (18).

The scientific rigor was evaluated, and the results are summarized in Table 2. Very few studies provided information about the reliability and validity of the outcome measures (17,18,23). Those studies that received ''no'' for treatment replication involved complex geriatric multidisciplinary teams that could only be replicated if the same team were involved (16–18,21,26). In addition, some studies were single-blinded to the treatment in that the staff performing the interventions could not be blinded (17).

Discussion and Conclusions

Through Sackett's rules of evidence for evaluating research, some support for physical therapy management of hip fracture in elderly persons has been shown. The levels of evidence and scientific merit were considered while forming conclusions. None of the 15 studies reviewed fulfilled all of the criteria for scientific rigor (Table 2). There is conflicting evidence as to the effectiveness of physical

Table 1. Levels of Evidence and Other Study Characteristics

Author(s)	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Barnes and Dunovan (12)	Case series; analysis of variables affecting ambulation status; Level V	70 inpatients in a geriatric rehabilitation center after hip fracture	Active–assistive, active, and resistive exercises, transfer training, ambulation training, modalities for pain relief	Varied; based on need for PT visits	Age, sex, number of visits to PT, pain, leg-length difference, side of fracture, motivation, orientation, alertness, previous leg fracture, and surgical repair with a prosthetic replacement or fracture pinning	Only previous leg fracture and the number of visits to PT showed a significant association with the patient's ability to reach prefracture ambulation status
Baker et al. (13)	Randomized, controlled, two factorial design; Level II	40 elderly women with fractured femoral neck	Group A: CG received conventional gait retraining ($n = 20$); Group B: treadmill gait retraining program ($n = 20$)	Varied; based on discharge from program	Mobility, length of hospital stay	Treadmill gait retraining had significantly better mobility outcomes
Crotty et al. (14)	Randomized, controlled trial; Level II	66 older adults admitted to acute care after hip fracture, assessed as needing rehabilitation	Group A: home-based rehabilitation ($n = 34$); Group B: hospital rehabilitation ($n = 32$)	1 y	Modified Barthel Index (MBI), Timed Up and Go (TUG) test, Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), and Caregiver Strain Index	Patients previously functionally independent can return home early and have the same outcome as those who stay in the hospital; less caregiver burden
Hauer et al. (15)	Prospective, randomized, controlled; Level II	28 elderly patients with a history of injurious falls admitted to acute care or inpatient rehabilitation because of acute fall-related hip fracture	Group A: intervention, lower extremity progressive resistance, balance training, and functional training ($n = 15$); Group B: CG ($n = 13$)	3 mo intervention; 3 mo follow-up	Strength, functional performance, balance, reduced fall-related behavior, and emotional problems	Lower extremity progressive resistance training and functional training increase strength and functional performance. Due to detraining, training regime should be continued.
Huusko et al. (16)	Randomized, controlled, intervention; Level I	243 community-dwelling hip fracture patients, 75 y/o or older	Group A: referred to geriatric ward for team rehabilitation; early ambulation, self-motivation and function ($n = 120$); Group B: referred to local hospitals for standard care ($n = 123$)	2 wk of intensive rehabilitation and 10 home PT visits; 4 y for overall study	Mortality, length of hospital stay, functional recovery, ADL, and IADL	Intensive geriatric rehabilitation can significantly decrease length of hospital stay and rehabilitation continues in the patient's home, especially for those who had functional deficits before surgery.

Table 1. Levels of Evidence and Other Study Characteristics (*Continued*)

Author(s)	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Huusko et al. (17)	Randomized, clinically controlled, subanalysis; Level I	243 patient aged 65 y/o or older, admitted to hospital with hip fracture	Group A: referred to geriatric ward; Group B: discharged to local hospitals	4 y	Length of hospital stay, mortality, place of residence 3 mo and 1 y after surgery	Hip fracture patients with mild or moderate dementia can return to community if they are provided with active geriatric rehabilitation.
Koot et al. (18)	Case series, prospective cohort study; Level V	215 patients aged 55–102 y, fractured hip during 1994	All received standardized Netherlands physiotherapy; interviews shortly after the injury, 4 and 12 mo later, radiographs, evaluation of case notes	1 y	Mobility, functional recovery	The chance of a patient with a hip fracture making any further recovery after 4 mo is minimal.
Kuisma (19)	Blocked randomized controlled clinical equivalence trial; Level II	81 patients with hip fracture	Group A: discharged home from the hospital, visited by a PT an average of 4.6 times ($n = 40$); Group B: CG; discharged to a rehabilitation center received physiotherapy daily ($n = 41$)	1 mo	Ambulation ability	Five visits by a PT in the patient's home after discharge yielded better results in ambulation ability than did 1 mo of conventional institution-based rehabilitation.
Naglie et al. (20)	Clinical trial, randomized, controlled; Level I	279 patients, 70 y/o or older, surgical repair of hip fracture	Group A: postoperative interdisciplinary care; biweekly goal-setting ($n = 141$); Group B: CG normal care ($n = 138$)	6 mo	Mortality, ambulation, transfers, residency	Postoperative interdisciplinary care did not result in significantly better outcomes in elderly patients with hip fracture (3 or 6 mo after surgery).
Penrod et al. (21)	Prospective, multisite observational study; Level V	443 hospitalized elderly patients discharged after surgery for hip fracture in 1997–1998	All received standard PT for after hip fracture (strength, mobility, gait training, modalities)	6 mo	Patient demographics, fracture type, comorbidities, dementia, number of new impairments at discharge, amount of PT between surgery and postoperative day (POD) 3/between POD 4 and 8 wk, 2-and 6-mo (Functional Independence Measure)	PT immediately after hip fracture surgery was associated with significantly better ambulation at 2 mo but was reduced at 6 mo.

Table 1. Levels of Evidence and Other Study Characteristics (*Continued*)

Author(s)	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Roder et al. (22)	Prospective longitudinal study; Level I	145 patients, 65 y/o or older, normal mental status, hip fracture	Group A: supervised inpatient rehabilitation in orthopedic hospital ($n = 69$); Group B: supervised inpatient rehabilitation in geriatric hospital ($n = 39$); Group C: CG; discharged home ($n = 34$)	1 y	ADLs and IADLs	Institutional rehabilitation after surgical treatment of hip fracture apparently had no significant impact on mortality and morbidity in older patients of normal mental status.
Sherrington and Lord (23)	Randomized controlled trial; Level II	40 people, >60 y, living independently or in institutional care, recruited, on avg., 7 mo after a fall-related hip fracture	Group A: home-based program of weight-bearing exercise ($n = 20$); Group B: CG ($n = 20$)	1 mo	Quadriceps strength, postural sway, functional reach, weight-bearing ability, walking velocity, and self-rated fall risk	Home-based weight-bearing program produces greater quadriceps strength, increased walking velocity, and reduced subjective falls risk.
Sherrington et al. (24)	Randomized controlled trial; 4-month follow-up; Level I	120 older people with hip fracture; 90% completed the 4-mo retest	Group A: weight-bearing home exercise group ($n = 4$); Group B: nonweight-bearing home exercise group ($n = 40$); Group C: CG; no exercise program ($n = 40$)	4 mo	Strength, balance, gait, and functional performance	A weight-bearing home exercise program can improve balance and functional ability to a greater extent than can a nonweight-bearing program (for balance and functional performance but not for strength or gait).
Sherrington et al. (25)	Blocked, randomized, controlled trial; Level II	80 people undergoing inpatient rehabilitation after fall-related hip fracture	Group A: weight-bearing exercise prescribed by a PT ($n = 41$); Group B: nonweight-bearing exercise ($n = 38$)	2 wk	Strength, balance, gait, and functional performance	Weight-bearing and nonweight-bearing exercise programs produce similar effects on strength, balance, gait, and functional performance (strength benefits for the nonweight-bearing group and functional benefits for the weight-bearing group improved ability to complete a lateral step-up).

Table 1. Levels of Evidence and Other Study Characteristics (*Continued*)

Author(s)	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Tinetti et al. (26)	Randomized controlled trial with 12 mo of follow-up; Level I	304 nondemented persons, at least 65 y/o, surgical repair of a hip fracture at two hospitals in New Haven, CT, and returned home within 100 d	Group A: Discharged to subacute facility for multicomponent rehabilitation strategy addressing both modifiable physical impairments (PT) and activities of daily living (ADL); Group B: CG; usual care	1 y	Battery of self-report and performance-based measures of physical and social function	The systematic multicomponent rehabilitation program was no more effective in promoting recovery than was usual home-based rehabilitation.

Note: CG = control group; PT = physical therapy/therapist; ADL = activity of daily living; IADL = instrumental activity of daily living.

therapy interventions for hip fracture in an elderly patient. It may be due to the nature of the elderly patient. Poor circulation, poor sensation, osteoporosis, decreased mobility, and depression may all be contributing factors to poor prognosis of hip fracture in elderly persons (3).

The recommendations offered in this review should be regarded cautiously. Five of the recommendations were based on low power studies of levels II and V, and one was based on a level I study. In addition, several of the level I studies resulted in conflicting evidence. These differences could be due to different research designs, outcome measures, or controls. However, some clinical recommendations can be provided:

- Treadmill gait training and weight-bearing exercises improve strength, ambulation, and functional status for elderly hip fracture patients.
- Physical therapy is beneficial for patients with dementia following a hip fracture.
- Home-based rehabilitation programs involving physical therapy are as beneficial as intensive hospital rehabilitation programs as long as they are started prior to 4 months after fracture.
- Finally, when a therapy program has been started on an elderly patient, the patient should continue with the exercise regime even after prefracture status has been attained.

It is difficult to isolate the role of physical therapy from that of other care received after hip fracture; therefore, it is difficult to generalize the most appropriate physical therapy management (20). Future research needs to attempt to isolate physical therapy from other disciplines. In addition, future research should focus on specific locations of the hip

Table 2. Evaluative Criteria for Studies Reviewed

Author(s)	Inclusion and Exclusion Criteria and Operational Definition of Hip Fracture	Treatment Can Be Replicated	Reliability of Outcome Measures Assessed	Validity of Outcome Measures Investigated	Blind Assessment of Outcome	Account for Attrition
Barnes and Dunovan (12)	N	Y	N	N	N	Y
Baker et al. (13)	Y	Y	N	N	Y	Y
Crotty et al. (14)	Y	Y	N	N	Y	Y
Hauer et al. (15)	Y	Y	N	N	N	Y
Huusko et al. (16)	N	N	N	N	Y	Y
Huusko et al. (17)	Y	N	Y	Y	N	Y
Koot et al. (18)	Y	N	N	Y	N	Y
Kuisma (19)	Y	Y	N	N	N	N
Naglie et al. (20)	Y	Y	N	N	Y	Y
Penrod et al. (21)	Y	N	N	N	N	Y
Roder et al. (22)	Y	Y	N	N	Y	Y
Sherrington and Lord (23)	Y	Y	Y	N	N	Y
Sherrington et al. (24)	Y	Y	N	N	Y	Y
Sherrington et al. (25)	Y	Y	N	N	Y	Y
Tinetti et al. (26)	Y	N	N	N	Y	Y

Note: Y = yes; N = no.

fracture as opposed to merely a universal ''hip fracture.'' Other recommendations would be to provide an operational definition of functional recovery after hip fracture, because many of the studies involved in this review had conflicting definitions of recovery of mobility and assessment of activities of daily living before and after fracture, among others.

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