

In the Clinic

Hip Fracture

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Physician Writers
Fernanda Porto Carriero, MD
Colleen Christmas, MD

Section Editors
Deborah Cotton, MD, MPH
Darren Taichman, MD, PhD
Sankey Williams, MD

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CME Objective: To review current evidence for the prevention, diagnosis, and treatment of hip fracture.

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Hip fracture is the most serious consequence of osteoporosis. About 1% of all falls in the elderly residing in the community result in hip fracture, often with life-changing consequences. Acute mortality from hip fracture is 3%–5%; the lifetime risk for death from hip fracture is similar to that from breast cancer. Far fewer than half of patients with hip fracture fully recover their ability to perform all of their basic activities of daily living. Outcomes are even more grim for those who have postoperative complications. Timely diagnosis and highly attentive perioperative care of the complex patient with a hip fracture aim to reduce the risk for such complications and to facilitate rapid transition to rehabilitation in the hopes of improving functional recovery.

Screening and Prevention

What medical comorbid conditions increase the risk for falls and hip fracture?

Comorbid conditions that increase the risk for falls include advanced age (older than 75 years), sensory impairments (such as hearing or vision loss), conditions that cause gait instability or abnormal proprioception, depression, muscular weakness, orthostatic hypotension, and impaired cognition. The use of ≥ 4 medications on a long-term basis, alcohol, and benzodiazepines can also increase the risk for falls (1, 2).

Osteoporosis increases the patient's risk for hip fracture when a fall occurs. Patients should be evaluated for risk for osteoporosis by eliciting historical risk factors for osteoporosis. Certain patients with risk factors should undergo bone densitometry. Risk factors include history of fracture, glucocorticoid use, family history of fracture, cigarette smoking, excessive alcohol consumption, and low bodyweight (3).

What are the mechanical risk factors for hip fracture?

Gait instability, foot deformities, and environmental hazards in the home all pose mechanical risks for fall. Patients with a history of or risk factors for falls should undergo interventions to reduce the risk for falls and fractures. Begin with an evaluation for risk factors, which should include a review of medications; review of home safety

(such as ensuring highly trafficked pathways are well lit and clear of clutter); a detailed history of falls; and testing of muscle strength, balance and gait, and neurologic function (particularly cerebellar function, proprioception, vision, and hearing). Interventions should then be targeted at reducing or eliminating risk factors.

Patients with multiple risk factors are at highest risk and probably need a review of their calcium and vitamin D intake, medication adjustment (including pharmacotherapy for osteoporosis and reduction of polypharmacy), smoking cessation, balance training, environmental safety evaluation, and strengthening exercises to reduce their risk for fracture (1).

Refer to The American Geriatrics Society published clinical practice guidelines for the prevention of falls in the elderly (4). Interventions to eliminate risk factors (Table 1) (including medication adjustment, exercise, and behavioral modification) significantly reduced falls in a community of older people (5). This finding was also supported in a meta-analysis (6).

What is the role of bone densitometry in assessing risk for hip fracture?

Bone densitometry is a valid method to diagnose osteoporosis

1. Cummings SR, Nevitt MC, Browner WS, et al. Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group. *N Engl J Med.* 1995;332:767-73. [PMID: 7862179]
2. Zuckerman JD. Hip fracture. *N Engl J Med.* 1996;334:1519-25. [PMID: 8618608]
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5. Tinetti ME, Baker DL, McAvay G, et al. A multifactorial intervention to reduce the risk for falling among elderly people living in the community. *N Engl J Med.* 1994;331:821-7. [PMID: 8078528]
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Table 1. Interventions to Eliminate Risk Factors for Hip Fracture

Risk Factor	Intervention
Age >75	
Sensory impairment	Vision correction, hearing aids
Gait instability	Physical therapy, assistive devices, strength and balance training
Foot deformities	Surgical correction, orthotic devices
Use of ≥4 chronic medications	Elimination of nonessential medications
Use of alcohol	Counseling to reduce or discontinue alcohol
Use of benzodiazepines	Reduction or discontinuation of benzodiazepines
Environmental hazards in the home	Ensure adequate lighting, install handrails in the bathroom and on the stairs, remove loose cords and rugs, store the most frequently used items in the kitchen within easy reach
Depression	Evaluation and treatment of depression
Muscular weakness	Physical therapy, exercise
Orthostatic hypotension	Behavioral modification (e.g., rising slowly from bed), reduction or elimination of medications that may worsen condition
Impaired cognition	Evaluation and treatment for dementia and for reversible causes of cognitive decline

FRAX: WHO Fracture Risk Assessment Tool

- Age
- Sex
- Weight
- Height
- History of previous fracture in adult life occurring spontaneously, or a fracture arising from trauma that, in a healthy individual, would not have resulted in a fracture.
- Parent fractured hip
- Current smoking
- Glucocorticoid use
- Rheumatoid arthritis
- Secondary osteoporosis—disorders strongly associated with osteoporosis, such as type 1 diabetes, osteogenesis imperfecta, untreated hyperthyroidism, hypogonadism, premature menopause, chronic malnutrition or malabsorption, and chronic liver disease.
- 3 or more units/day of alcohol
- BMD

Adapted from FRAX calculation tool Web site: www.sheffield.ac.uk/FRAX/tool.jsp.

and to predict the risk for fracture. The fracture-risk assessment tool (FRAX) (see the Box) integrates risk factors with bone densitometry measurement to predict 10-year risk for sustaining hip fracture. Factors that are most highly predictive of an osteoporotic fracture are a history of previous low-impact fracture and low bone mineral density (BMD) (7).

A meta-analysis showed that a 1-SD decrease in bone mineral density at the femoral neck was associated with a relative risk for hip fracture of 2.6 (8).

How often should bone densitometry be performed?

The U.S. Preventive Services Task Force has updated its screening recommendations for osteoporosis to women aged 65 years or older and in younger women whose fracture risk is equal to or greater than that of a 65-year-old white woman who has no additional risk factors. At this time, the U.S. Preventive Services Task Force does not make recommendations regarding screening intervals. Repeated screening has not been shown to be more predictive of subsequent fracture than the original screening measurement (9).

A prospective study of 4124 women aged 65 years or older found that neither repeated BMD measurement nor change in BMD after 8 years was more predictive of subsequent fracture risk than the original measurement. It may be useful, however, to rescreen patients if there is clinical suspicion for greater-than-average acceleration of BMD loss (10).

What pharmacologic interventions can prevent hip fracture?

Patients with known osteoporosis or risk factors for osteoporosis should be treated to prevent hip fracture. Effective therapies exist that have been shown to reduce fractures in both men and women with osteoporosis.

Antiresorptive agents: calcium and vitamin D

Inadequate intake of calcium and vitamin D leads to reduced calcium absorption, causing an increase in parathyroid hormone and subsequent increased bone loss. Vitamin D deficiency is also linked to reduced muscle function and higher risk for falling (3).

A meta-analysis of randomized, controlled trials (RCTs) showed that, compared with calcium or placebo, a vitamin D dose of 700–800 IU/d reduced the relative risk for hip fracture by 26% (11).

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A follow up meta-analysis looked at RCTs of oral vitamin D with or without calcium supplementation. Results suggested that oral vitamin D reduces risk for hip fracture only when supplemented with calcium (12).

The form and dose of vitamin D are a matter of debate. A meta-analysis of randomized trials suggested significant fracture reductions with higher doses of vitamin D administered and higher levels of serum 25-hydroxyvitamin D achieved in both community-dwelling and institutionalized older individuals (13).

However, very high doses of vitamin D have been shown to increase the risk for falls and fractures compared with placebo.

An RCT of 2256 community-dwelling women at high risk for fracture were assigned to receive 500 000 IU of cholecalciferol or placebo each autumn to winter for 3–5 years. Results showed that high-dose cholecalciferol resulted in an increased risk for falls and fractures compared with placebo (14).

Bisphosphonates: alendronate, risedronate, ibandronate, and zoledronic acid

Bisphosphonates inhibit osteoclastic bone resorption and have been shown to reduce the risk for hip fractures in women with osteoporosis.

Clinical trials of bisphosphonate therapy show reductions in risk for nonvertebral fracture, including hip fracture, of 20%–40% (3).

A recent study showed a significant dose-dependent loss of protection against hip fracture in patients receiving alendronate and a proton-pump inhibitor (15).

Hormone replacement therapy: estrogen

Estrogen has been shown to prevent a decrease in BMD. However, this therapy is associated with several health risks, such as breast cancer, coronary artery disease, stroke and thromboembolism. Therefore, it is not considered first-line therapy in management of postmenopausal osteoporosis (3, 16, 17).

Selective estrogen-receptor modulators: raloxifene and risedronate

Selective estrogen-receptor modulators have been studied in numerous trials and have been shown to have a beneficial effect on vertebral fractures but not nonvertebral fractures in patients with osteoporosis. However, these drugs do increase the risk for venous thromboembolism (3).

A large observational study evaluated women 65 years and older initiating either risedronate or raloxifene therapy. Women in the risedronate group had more risk factors for fracture at the time therapy was started. The study found that risedronate treatment in adherent patients rapidly decreased the risk for hip fractures, whereas raloxifene treatment did not (18).

Anabolic therapy: parathyroid hormone and strontium ranelate

Parathyroid hormone stimulates bone formation and has been shown to decrease the risk for vertebral fractures. However, the evidence is less strong for its benefits in reducing hip fractures. Parathyroid hormone therapy is limited to 2 years because of concerns for long-term safety (19).

Strontium ranelate seems to simultaneously increase bone formation and decrease bone resorption, thus uncoupling the bone remodeling process. Data support the efficacy of strontium ranelate for the reduction of vertebral fractures (and to a lesser extent nonvertebral or hip fractures) in postmenopausal osteoporotic women over a 3-year period. Strontium ranelate increases the risk for diarrhea (20).

Calcitonin

Calcitonin decreases bone resorption and has been approved for treatment of osteoporosis. It is, however, less potent than other antiresorptive therapies and has not been shown to reduce hip fracture and therefore is not considered first-line therapy for treatment of osteoporosis (21).

Monoclonal antibody: denosumab

Denosumab is a monoclonal antibody that inhibits development and activity of osteoclasts, decreasing bone resorption and increasing bone density. It has been approved by the U.S. Food and Drug Administration for treatment of osteoporosis in postmenopausal women at high risk for fracture. Although generally well-tolerated, diarrhea, nausea, and achiness have been noted in about 1 in 5 women receiving this therapy. Calcium and phosphate levels must also be monitored during therapy.

An RCT of 7868 women with a BMD T score less than -2.5 but not less than -4.0 at the lumbar spine or total hip were assigned either denosumab or placebo every 6 months for 36 months. Results showed that denosumab reduced the risk for hip fracture with a cumulative incidence of 0.7% in the denosumab group vs. 1.2% in the placebo group (hazard ratio, 0.60; 95% CI, 0.37-0.97; P = 0.04), indicating a relative decrease of 40% (22).

What is the role of exercise in preventing hip fracture?

Risk factors for falls and fractures include physical inactivity, inability to rise from a chair without using the arms, gait instability, and lower-extremity weakness. Exercise can reduce the risk for falls and fractures in appropriate patients.

The Study of Osteoporotic Fracture trial showed that exercise reduced the risk for hip fracture by 33% (23). Home-based

exercise programs demonstrate a non-significant trend toward hip fracture reduction (24). A meta-analysis of the Frailty and Injuries: Cooperative Studies of Intervention Techniques study found that exercise, particularly with balance training or t'ai chi, reduces the risk for falls (25).

Can home safety evaluations prevent hip fracture?

The American Geriatrics Society has published clinical practice guidelines for the prevention of falls in the elderly. Their recommendations include a home environment assessment and intervention carried out by a health care professional for older people who have fallen or have risk factors for falls (4).

Hip fractures often occur after falls, but there has been controversy over the effectiveness of home safety evaluations. A meta-analysis of randomized trials found that home assessment interventions can reduce falls by 39% among populations at high risk for falls (26).

Can hip protectors prevent hip fracture?

The results of a recently updated Cochrane review suggest that the effectiveness of hip protectors in reducing hip-fracture risk in elderly people is still not clearly established. Hip protectors may reduce the risk for hip fracture in nursing home residents but not in community dwelling elderly people. Compliance is poor (27).

Screening and Prevention... Risk assessment tools, such as FRAX, which combine identification of risk factors for falls and bone densitometry, can predict the 10-year risk for sustaining hip fractures. Interventions aimed at eliminating risk factors, as well as pharmacologic therapies for osteoporosis (such as vitamin D and calcium supplementation, bisphosphonates, and monoclonal antibodies), have been shown to reduce the risk for hip fractures.

CLINICAL BOTTOM LINE

What is the differential diagnosis of hip fracture?

A careful history and physical examination usually distinguishes a

hip fracture from other disorders that present as pain in the hip area. Differential diagnosis includes referred pain from lumbar spine

Diagnosis and Evaluation

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Differential Diagnosis for Hip Fractures

Pathologic fracture
Pelvic fracture
Osteoarthritis
Osteonecrosis
Rheumatoid arthritis affecting the hip
Septic hip joint
Dislocation
Soft tissue injury
Trochanteric bursitis
Meralgia paresthetica (lateral femoral cutaneous nerve entrapment)
Pathology referred from the lumbar spine (e.g., spinal stenosis, arthritis, disk disease)
Paget disease (osteitis deformans)

disease, various arthritides, periarticular disease, and certain neurologic disorders (see the Box). Radiographs can help distinguish hip fracture from other pathologic conditions.

What characteristics of a fall are most predictive of hip fracture?

Studies show that fall characteristics, such as fall direction and fall energy, are independent risk factors for fractures.

A study of fall severity as a risk factor for hip fracture in ambulatory elderly persons showed that a fall to the side and higher fall energy were at least as important as BMD in determining hip fracture risk (28).

A study of fall direction as a risk factor for hip fracture in frail elderly nursing home patients showed that a sideways fall was an independent risk factor for hip fracture (odds ratio for fall with hip fracture, 5.7 [CI, 1.7–18]; P 0.004 compared with patients who fell and did not sustain a fracture) (29).

What are the important elements of the history when hip fracture is suspected?

The patient should be asked about the location and characteristics of pain, which is usually felt in the groin or buttock but can be referred to the knee. The circumstances of the fall and any history of trauma or height loss should be elicited. A general medical history should also be obtained, focusing on premonitory conditions and function (Table 2).

Are physical examination findings of comorbid conditions (cardiac disease, cognitive impairment) predictive of hip fracture after a fall?

Examination findings that suggest rheumatoid arthritis, hypogonadism, chronic glucocorticoid use, or kyphosis may be associated with

osteoporosis and increase the risk for hip fracture with a fall.

What physical examination signs are helpful to diagnose hip fracture and to distinguish it from other causes of hip pain?

Physical examination can confirm the diagnosis of hip fracture. The injured leg is often shortened, externally rotated, and abducted when the patient is in the supine position.

What are the different types of hip fracture?

Hip fractures are classified by the area of the upper femur affected and by whether displacement is present. The 3 types of hip fracture are intracapsular fractures at the level of the head and neck of the femur; intertrochanteric fractures between the neck of the femur and the lesser trochanter; and subtrochanteric fractures, which occur below the lesser trochanter (30).

What other injuries commonly occur with hip fracture?

In patients who present with a hip fracture after a fall, a search for other soft tissue injuries and other sites of fracture is warranted. Ask specifically whether concomitant head trauma occurred and examine the head for evidence of such. Some patients with hip fracture will have remained on the ground for a prolonged time, increasing their risk for deep venous thrombosis (DVT), skin ulceration, pneumonia, and rhabdomyolysis.

What radiographs and other imaging studies are used?

Radiographs are the cornerstone of diagnosis and are important in determining whether surgical repair is warranted. First, obtain plain anteroposterior or pelvis and lateral radiographs.

26. Clemson L, Mackenzie L, Ballinger C, Close JC, Cumming RG. Environmental interventions to prevent falls in community-dwelling older people: a meta-analysis of randomized trials. *J Aging Health*. 2008;20:954-71. [PMID: 18815408]
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If clinical suspicion remains high and plain radiographs are negative, obtain magnetic resonance imaging (MRI) to evaluate for occult fracture. A bone scan may be useful to diagnose fracture in patients who cannot

undergo MRI, but may take up to 72 hours to register as positive.

In studies of patients with suspicion of hip fracture but negative plain radiographs, MRI showed occult femoral fracture in 37% to 55% (31, 32).

Table 2. History and Physical Examination Elements for Hip Fracture

Category	Element	Notes
History	Trauma, particularly a fall from a standing position with impact directly on the hip	
	Hip pain (groin or buttock)	Rarely, pain may radiate or be referred to the knee or thigh
	Inability to bear weight or pain with weight-bearing	
	Circumstances surrounding fall	To identify unstable medical illness before surgery and to identify potential areas for secondary prevention
	Previous minimal trauma fracture or loss of height	
	Risk factors for osteoporosis and fracture (e.g., sedentary lifestyle; excessive alcohol or tobacco use; weight loss since age 25; maternal history of hip fracture; use of psychoactive medications; use of seizure medications; hyperthyroidism; low dietary intake of calcium or vitamin D; and comorbid conditions, such as dementia and sensory deficits)	
	Cardiovascular disease and other comorbid conditions	Preoperative evaluation to determine if further testing or treatment is necessary before surgical repair, only in some circumstances (see text)
Physical examination	Premorbid function	Predicts morbidity and mortality after hip fracture
	Observation of position and length of painful limb and gentle range-of-movement determination	Most patients do not tolerate anything more than a gentle attempt to roll the limb
	Musculoskeletal and neurologic survey	To evaluate for evidence of concomitant injury; particular consideration should be given to evaluation for head trauma
	Evaluation of distal motor, sensory, and vascular integrity of the affected limb	To evaluate for interruption of the neurovascular blood supply at the level of the injury
	Cardiac examination	To evaluate particularly for evidence of arrhythmia, congestive heart failure, valvular disease, or uncontrolled hypertension that may need to be managed before surgery
	General physical examination	To identify unstable comorbid illnesses that may need preoperative evaluation and treatment or that may predict complications in recovery after fracture
	Mental status testing	Delirium occurs in up to 60% of patients with acute hip fracture; the presence of cognitive impairment is a strong risk factor for development of delirium in the hospital and of worse recovery after hip fracture

31. Bogost GA, Lizerbram EK, Crues JV 3rd. MR imaging in evaluation of suspected hip fracture: frequency of unsuspected bone and soft-tissue injury. *Radiology*. 1995; 197:263-7. [PMID: 7568834]
32. Pandey R, McNally E, Ali A, Bulstrode C. The role of MRI in the diagnosis of occult hip fractures. *Injury*. 1998;29:61-3. [PMID: 9659484]

Diagnosis... History and physical examination distinguish hip fracture from other disorders that present as hip pain. Hip radiographs are important for diagnosis and for determining whether surgical repair is warranted.

CLINICAL BOTTOM LINE

Treatment and Management

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When should conservative therapy for be considered?

Surgical repair is the cornerstone of therapy for hip fracture and has the best opportunity for functional recovery. Conservative therapy should be considered for patients who are too ill for surgery or anesthesia, patients who were bed- or wheelchair-bound before injury, or if modern surgical facilities are unavailable.

A Cochrane review of 5 randomized trials found no differences in medical complications, mortality, or long-term pain in conservative vs. surgical therapy for hip fracture. However, surgery was more likely to result in fracture healing without deformity and a shorter hospital stay (33).

Is there a role for traction in conservative management of patients with hip fracture?

No evidence indicates that skeletal or skin traction is beneficial for patients with hip fracture. In fact, traction may be associated with its own risks, such as increased patient discomfort, limited ability for bedpan transfer, increased immobility, and skin tears.

A review presented by the Cochrane Musculoskeletal Injuries Group did not show any significant benefit from use of pre-operative traction in patients with hip fracture (34).

During what time frame should surgery be performed?

Hip fracture should be surgically repaired as soon as the patient is medically stable, although the precise timing of surgery remains controversial.

Retrospective cohort studies generally show that long-term mortality is reduced when surgery is performed within 24 to 48 hours; however, data on morbidity conflict, and many of the studies do not give a reason for surgical delay (e.g., medical instability) (35–38).

When should surgery be postponed?

Surgery should be postponed if the patient has one or more unstable medical conditions, such as active heart failure, ongoing angina, or a serious infection. Any medical condition that causes hemodynamic instability should be corrected before fracture repair.

How is the appropriate surgical approach determined?

First, identify the location of the fracture and the severity of displacement, if any. Femoral neck fractures are repaired by either internal fixation with screws (if nondisplaced or minimally displaced in younger patients) or with prosthetic replacement (if displaced or in patients with concomitant poor bone quality, joint disease, or an excessive propensity to fall). Intertrochanteric fractures are repaired with sliding screws or other similar devices, depending on the bone quality and the surgeon's preference. Subtrochanteric fractures can be treated with an intramedullary nail or a screw-plate fixation. The results of 1 randomized trial supported use of an intramedullary nail rather than screw-plate fixation; patients treated with the former method had shorter surgical times, fewer blood transfusions, shorter hospital stays, and fewer implant failures and/or nonunions than patients treated with a screw plate (39).

Note that displaced intracapsular hip fractures are very likely to disrupt the vascular supply to the femoral head, resulting in nonunion and osteonecrosis (up to 40%) if not treated with replacement arthroplasty (2, 40). Nondisplaced femoral neck and intertrochanteric fractures are less vulnerable to these complications and can often be treated adequately with internal fixation.

Should preoperative cardiac risk be assessed in all patients who will have surgery for hip fracture?

Orthopedic surgery is considered to have an “intermediate” cardiovascular risk; only patients with severe or unstable cardiac conditions are likely to benefit from revascularization before surgical hip repair. Thus, invasive and noninvasive cardiac testing are not indicated in hip fracture patients without comorbid cardiac conditions.

The American College of Cardiology/American Heart Association (ACC/AHA) Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery recommends perioperative testing and treatments only for the following specific cardiac conditions:

- Unstable coronary syndromes, such as unstable angina, acute myocardial ischemia or infarction, and recent myocardial infarction
- Decompensated heart failure
- Significant atrial arrhythmias, such as symptomatic bradycardia, high-grade atrioventricular block, supraventricular arrhythmias with rapid ventricular rate at rest, and atrial fibrillation with rapid ventricular rate at rest
- Ventricular arrhythmia
- Severe valvular disease.

Recommendations for perioperative medical therapies to reduce risk in patients with stable coronary artery disease have been updated in recent years. The ACC/AHA recommends continuation of

β -blocker therapy in patients already receiving this therapy for angina, arrhythmia, and hypertension. They also recommend β -blockers to patients with identified coronary artery disease or high cardiac risk having intermediate-risk surgery (41, 42).

The ACC/AHA Guidelines for perioperative testing and therapy offer a complete set of recommendations. Consultation with a cardiologist may also benefit a certain subset of patients (41, 43).

What is the status of minimally invasive approaches for hip fracture repair?

Minimally invasive surgical approaches for repair of intertrochanteric hip fractures result in lower rates of blood transfusions but no difference in mortality (44).

What is the expected mortality of hip surgery?

Surgical-specific mortality after hip fracture repair is 2%–3% in most U.S. hospitals; however, hip fracture confers a 5-fold increase for women and an 8-fold increase for men in all-cause mortality compared with age- and sex-matched controls in the first 3 months after fracture (45).

What are the major postoperative complications of hip fracture?

Major postoperative complications of hip surgery include infection, dislocation and failure of the prosthesis, delirium, DVT, skin breakdown, and bladder problems. What should be evaluated to assess these risks and other appropriate follow-up measures are shown in Table 3.

Outpatient providers should be aware that late postoperative complications may occur months to years after repair and include osteonecrosis of the femoral head (after internal fixation), loosening of the prosthesis (after arthroplasty), and persistent pain (46, 47).

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When should rehabilitation begin following surgery for hip fracture?

Rehabilitation is a key component of treatment and should begin on the first postoperative day. Most patients should get out of bed on the first postoperative day, with progression to ambulation as soon as tolerated to prevent pressure ulcer formation, atelectasis, pneumonia, and muscle weakness.

More intense physical therapy within the first 3 days after surgery has been shown to be associated with improved ambulation 2 months after surgery; however, the improvement is attenuated by 6 months after surgery compared with less intense physical therapy in the first 3 days after surgery (48).

What are the goals of rehabilitation and how are they best accomplished?

The goals of rehabilitation are focused on regaining the previous level of ambulation and independence. The best strategies to improve mobility after hip fracture, however, have not been determined.

Most studies of rehabilitation strategies are small and methodologically limited (49).

What is the role of prophylactic antibiotics for patients who are having surgery for hip fracture?

Prophylactic antibiotics should be administered to all patients, including those having surgery for closed fracture fixation, as they decrease the rates of deep wounds, superficial wounds, and urinary tract infections (50)

The first dose of prophylactic antibiotics is given before surgery and continued for 24 hours after surgical repair. First- and second-generation cephalosporins have been used most often in trials.

Meta-analyses have shown a 44% lower risk for infectious complications with antibiotic use vs. placebo and a 40% reduction of infection with multiple vs. single doses (51).

What the major components of pain management for hip fracture?

Provide adequate analgesia to all patients with hip fracture, regardless of whether they have surgery. Analgesia increases patient comfort, facilitates rehabilitation, and decreases the risk for delirium.

A large prospective study found that patients with higher postoperative pain scores had longer hospital stays and worsened short- and long-term functional recovery (52).

Adequate doses of narcotics should be used to control pain, but meperidine should be avoided because it is strongly identified as a risk factor for delirium (53, 54).

How common is thromboembolism following a hip fracture, and should it be prevented and treated?

Rates of DVT up to 50% have been reported in patients with hip fracture not treated prophylactically. The rate of fatal pulmonary embolism was reported to be in the range of 1.4%–7.5% within 3 months after hip fracture surgery (55, 56).

Unless contraindicated, all patients should be treated with fondaparinux, low-dose unfractionated heparin, adjusted-dose vitamin K antagonist, or low-molecular-weight heparin to reduce the rate of thromboembolic complications.

A randomized trial sponsored by the makers of fondaparinux comparing that drug with enoxaparin showed lower rates of (largely asymptomatic) DVT with fondaparinux, without any difference in bleeding or death. Fondaparinux is more expensive than enoxaparin, heparin, or vitamin K antagonists (57).

Randomized trials that compared unfractionated or low-molecular-weight heparins with control showed a 59% reduction in DVT (51, 55, 58).

For patients undergoing hip fracture surgery, the American College of Chest Physicians (ACCP) recommends the routine use of fon-

Table 3. Elements of Postoperative Follow-up for Hip Fractures

Category	Issue	How?	How Often?	Notes
History	Pain control	Ask if pain is severe or if it is limiting therapy	At least daily while an inpatient, then periodically	Pain medications may need adjustment; new or increasing pain may warrant evaluation of stability of repair or for evidence of deep venous thrombosis or wound infection; evidence is insufficient to recommend one form of pain control over another (e.g., PCA pump vs. oral therapy), but most patients require narcotic therapy post-operatively, which can be tapered during recovery
	Bladder control	Ask how much the patient has voided and whether dysuria is present	At least daily during acute hospitalization	Postoperative urine retention and infection are common; the Foley catheter should be removed on postoperative day 1, then straight catheterization may be used if needed
Physical examination	Delirium	Monitor for confusion or altered level of consciousness	At least daily during acute hospitalization	A standardized screening tool, such as the Confusion Assessment Method, may be useful for diagnosis; altered mentation should prompt a search for the underlying cause
	Pressure ulcer	Examine skin for evidence of breakdown	Daily during acute hospitalization, then periodically until full mobility is achieved	Daily during acute hospitalization, then periodically until full mobility is achieved
	Deep venous thrombosis	Check for unilateral edema, erythema, warmth, and palpable venous cord		Venous Doppler ultrasonography may be useful for evaluation if clinical suspicion warrants it
History and physical examination	Infectious complications	Observe vital signs; examine lungs and wound; ask about symptoms of fever, cough, leg pain, or dysuria		Daily during acute hospitalization, then during outpatient follow-up as symptoms warrant
	Cardiac complications	Ask about symptoms of chest pain, nausea, dyspnea, or diaphoresis; examine heart and lungs	Daily during acute hospitalization	Delirium may be the sole presentation for acute MI or CHF in the elderly; electrocardiography may be helpful
	Falls	Ask about recent falls and the circumstances surrounding them; perform neurologic and musculoskeletal examinations, focus particularly on gait and balance	Periodically at each outpatient visit	Assess efficacy and compliance with a falls-prevention program
Laboratory data	Postoperative complications	Check hematocrit and electrolyte levels	Daily during acute hospitalization until stable	
Nondrug therapy	Rehabilitation	Ask patient and therapist and observe functional abilities	Daily while an inpatient, then periodically	
History, physical examination, and laboratory data	Osteoporosis	Review medications, diet, alcohol and tobacco use, and exercise history; check serum TSH, 25-hydroxy vitamin D, calcium, phosphorus, and alkaline phosphate levels; consider checking serum and urine and protein electrophoresis or DEXA; oral bisphosphonate therapy should be held off during hospitalization until the patient is able to take it with 8 oz of water and remain upright for 30 minutes before eating, drinking, taking other medications, or reclining	At the first outpatient follow-up appointment	Evaluate for diseases or conditions that cause or exacerbate osteoporosis, and treat those that are amenable to therapy; initiate specific osteoporosis treatment based on individual patient characteristics then monitor for side effects, compliance, and efficacy; DEXA may be useful for monitoring therapy to enhance compliance, but its cost-effectiveness is debated; because of ease of administration and reported ability to alleviate pain, calcitonin nasal spray may be initiated with calcium and vitamin D supplementation during hospitalization; evidence is insufficient that any osteoporosis therapies improve fracture healing rates

CHF = congestive heart failure; DEXA = dual-energy x-ray absorptiometry; MI = myocardial infarction; TSH = thyroid-stimulating hormone.

daparinux, low-molecular-weight heparin, vitamin K antagonist (target international therapeutic range, 2.5; range, 2.0 to 3.0) or low-dose unfractionated heparin. They also recommend against the use of aspirin alone. Mechanical prophylaxis is recommended if anticoagulant prophylaxis is contraindicated because of a high risk for bleeding.

The duration of prophylaxis is controversial. Studies show that the risk for venous thromboembolism begins soon after fracture. Prophylaxis should, therefore, begin before surgery if the procedure is likely to be delayed and should be restarted once postoperative hemostasis has been demonstrated. The ACCP recommends that patients undergoing hip fracture surgery be given extended prophylaxis for up to 28–35 days after surgery (59).

What is the correct approach to secondary prevention in patients who have had a hip fracture?

Outpatient follow-up includes evaluation of return of function, monitoring for late postoperative complications, and institution of secondary prevention measures.

Analysis of data from the Framingham Heart Study showed that 2.5% of patients with hip fracture have a second hip fracture in the first year and 8.2% do so within 5 years of the first fracture (60).

Secondary prevention measures include treatment for osteoporosis and fall prevention.

A prospective, blinded, placebo RCT sponsored by industry showed that annual infusion of zoledronic acid started within 90 days after hip fracture and accompanied by daily calcium and vitamin D supplementation reduced both new fractures and mortality after hip fracture in the mean 1.9 years of follow-up (61).

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Treatment and Management... Surgical repair of hip fracture provides the best opportunity for functional recovery. Studies show that surgery performed within 24–48 hours reduces long-term mortality and should be done if the patient is medically stable. Perioperative cardiac testing and treatments are recommended only for specific cardiac conditions. Perioperative antibiotics reduce the risk for infectious complications. Postoperative anticoagulation is recommended to reduce the rates of DVT. Secondary prevention, including treatment for osteoporosis and efforts to reduce falls, is also indicated.

CLINICAL BOTTOM LINE

Patient Education

What should patients be told about primary prevention of hip fracture?

Patients should be educated about osteoporosis and its implications for risk for subsequent fractures if left untreated. They should also be educated about their future risk for falls and what they can do to prevent them. Poor vision, muscular weakness, certain medications, and many environmental

factors are modifiable risk factors.

What should patients be told about immediate care after a fall and the detection of hip fracture?

Hip fracture and subsequent hospitalization are stressful to patients and their families. Knowing what to expect may alleviate some concern and guide modifications of the home

or living arrangements to accommodate the increased needs of the patient. Approximately 50% of patients regain ambulatory status, and most gains in function are made in the first 6 months after fracture repair (2).

Patients and their caregivers should be told that, barring any unstable medical conditions requiring preoperative treatment, most patients have the fracture repaired in the first day or two of hospitalization. They should also be told that rehabilitation is likely to begin on the first day after surgery, a 2-week stay in a rehabilitation facility is required before they can return home safely, and they will require assistance at home and further therapy for several months.

What should patients with a hip fracture be told about the risk for recurrent fractures and how to prevent them?

Analysis of data from the Framingham Heart Study showed that

2.5% of patients with hip fracture have a second hip fracture within the first year and 8.2% do so within 5 years of the first fracture (60).

Commonly, patients with prior fractures are found to be receiving no specific therapy for osteoporosis at the time of their subsequent hip fracture, suggesting the opportunity to diagnose and treat osteoporosis before a hip fracture is missed. Therefore, it is important to educate patients about osteoporosis and its implications for risk for subsequent fractures if left untreated. Explain to the patient that he or she has “brittle bones” and requires therapy to reduce the chances of breaking other bones. Patient education can be instrumental in secondary prevention. Often, it is better if this information is delivered a few days after the fracture repair, when the patient is focusing on rehabilitation and recovery.

Patient Education... Patients and their families should be educated on treatment for hip fractures and postoperative physical rehabilitation. They should also be educated on how to prevent future hip fractures. Interventions should include assessment of risk factors for falls and therapy for osteoporosis.

CLINICAL BOTTOM LINE

What measures do U.S. stakeholders use to evaluate the quality of care for patients with hip fracture?

The Assessing Care of Vulnerable Elders, 3rd Set (ACOVE-3), quality indicators that are relevant to management of patients with hip fracture are those assessing perioperative care, falls, and osteoporosis management (62).

What do professional organizations recommend regarding the care of patients with hip fracture?

There are no guidelines from U.S. professional organizations; however, evidence-based guidelines for hip fracture management from Australia were published in 2008 and are consistent with the content of this manuscript (63).

Practice Improvement

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In the Clinic Tool Kit

Hip Fracture

PIER Module

<http://pier.acponline.org/physicians/diseases/d165/d165.html>

PIER module on hip fracture from the American College of Physicians (ACP). PIER modules provide evidence-based, updated information on current diagnosis and treatment in an electronic format designed for rapid access at the point of care.

Patient Information

www.annals.org/intheclinic/toolkit-hip-fracture.xhtml

Patient information that appears on the following page for duplication and distribution to patients.

www.nlm.nih.gov/medlineplus/hipinjuriesanddisorders.html

www.nlm.nih.gov/medlineplus/tutorials/hipreplacement/hm/index.htm

www.nlm.nih.gov/medlineplus/spanish/tutorials/hipreplacementspanish/hm/index.htm

Information on hip injuries and disorders from National Institutes of Health's MedlinePLUS, including an interactive tutorial on hip replacement in English and Spanish.

www.niams.nih.gov/Health_Info/Bone/Osteoporosis/Fracture/prevent_falls.asp

Information on preventing falls and related fractures from the National Institute of Arthritis and Musculoskeletal and Skin Diseases.

www.cdc.gov/ncipc/factsheets/adulthipfx.htm

Information on hip fracture among older adults from the Centers for Disease Control and Prevention.

Clinical Guidelines

www.annals.org/content/149/6/404.full

Clinical practice guideline on the pharmacologic treatment of low bone density or osteoporosis to prevent fractures from the American College of Physicians.

www.nof.org/professionals/clinical-guidelines

Clinician's Guide to Prevention and Treatment of Osteoporosis, from the National Osteoporosis Foundation, released in 2008.

Diagnostic Tests and Criteria

www.uspreventiveservicestaskforce.org/uspstf10/osteoporosis/osteors.htm

Recommendations for screening for osteoporosis in postmenopausal women, from the U.S. Preventive Services Task Force, published in 2011.

<http://pier.acponline.org/physicians/diseases/d165/tables/d165-t6.html>

Garden classification of femoral neck fractures.

<http://pier.acponline.org/physicians/diseases/d165/tables/d165-t7.html>

Types of hip fracture repair.

Quality of Care Guidelines

www.qualitymeasures.ahrq.gov/

AHRQ quality indicator measure #19 for assessing the hip fracture mortality rate (the number of deaths per 100 discharges with principal diagnosis of hip fracture).

THINGS YOU SHOULD KNOW ABOUT HIP FRACTURE

In the Clinic
Annals of Internal Medicine

What is hip fracture?

- A break near the top of the long bone running through the thigh (the femur), near the hip joint.
- Pain after hip fracture may be felt in the groin or buttock, and possibly the thigh or knee.
- Flexing or rotating the hip will cause discomfort.

What causes hip fracture?

- The fracture usually occurs after a fall or some other trauma.
- Most hip fractures occur in people older than 65 years, as aging bones become gradually weaker and more susceptible to breaks.
- Osteoporosis is the main risk factor.
- About 70% of hip fractures occur in women.

How is it treated?

- An x-ray or magnetic resonance imaging (MRI) is used to confirm diagnosis.
- Surgery is usually required for repair.
- The procedure is based on the location and extent of the fracture, patient age, and the surgeon's expertise.
- In rare cases, treatment is nonsurgical. Nonsurgical treatment is usually reserved for patients who are too sick to have surgery or those who were unable to walk before the injury.

What are common complications?

- It is important to start moving around soon after surgery to speed recovery and reduce complications.
- It is usually necessary to use a walker, cane, or crutches and to participate in physical therapy for several months after surgery.
- Muscle deterioration and weakness can lead to permanent loss of mobility.
- Patients on bed rest are at increased risk for infections, bed sores, pneumonia, blood clots, and nutritional wasting.



- People who have one hip fracture are significantly more likely to have another.

How can hip fracture be prevented?

- Keep bones strong by eating a nutritious diet with adequate amounts of calcium and vitamin D.
- Be physically active to help maintain bone strength.
- If you have osteoporosis, talk to your doctor about medicines that treat or prevent bone loss.
- Prevent falls by remedying household hazards like slippery floors, poor lighting, and cluttered walkways.
- Stairways should have handrails.
- Review your medicines with your doctor and take only as directed.
- Wear well-fitting, low-heeled shoes, and use walking aids correctly.

For More Information

<http://orthoinfo.aaos.org/topic.cfm?topic=A00305>
Information on preventing broken hips from the American Academy of Orthopedic Surgeons.

www.nlm.nih.gov/medlineplus/ency/article/007386.htm
www.nlm.nih.gov/medlineplus/ency/patientinstructions/000168.htm
Information on hip fracture surgeries and on postsurgical care from the National Institutes of Health's MedlinePLUS.

<http://nihseniorhealth.gov/osteoporosis/toc.html>
Patient information on osteoporosis from NIHSeniorHealth

ACP

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1. An 87-year-old woman comes to the office for a routine evaluation. She reports that she has fallen once or twice a month for the past 4 months. The falls happen at various times of the day and occur immediately after standing up or after standing for some time. She does not experience dizziness, lightheadedness, vertigo, palpitations, chest pain or tightness, focal weakness, loss of consciousness, or injury at the time of the falls. The patient lives alone. Medical history includes hypertension and degenerative joint disease of both knees. Medications are acetaminophen and hydrochlorothiazide.

On physical examination, temperature is normal, blood pressure is 135/85 mm Hg without postural change, pulse rate is 72/min, and respiration rate is 16/min. Visual acuity with glasses is 20/40 on the right and 20/60 on the left. Cardiopulmonary examination is normal.

There is bony enlargement of both knees without warmth or effusion. On balance and gait screening with the "get-up-and-go" test, the patient must use her arms to rise from the chair. Neurologic examination, including cerebellar testing and a Romberg test, is normal. The patient's score on the Mini-Mental State Examination is 26/30 (normal $\geq 24/30$).

Results of a complete blood count and blood chemistry studies are normal.

Which of the following should be included as part of her management at this time?

- A. Begin risdrionate
- B. Measure serum 25-hydroxyvitamin D level
- C. Prescribe hip protectors
- D. Schedule 24-hour electrocardiographic monitoring

2. An 83-year-old woman who is recuperating from hip replacement surgery was evaluated on the orthopedic floor of a hospital when she became

confused and was found on the floor of her room at about 3 am. Her assessment found no sign of injury, and vital signs were normal. The patient was released from the hospital without further incident 2 days later. The patient's medical history is significant for osteoporosis and hypothyroidism. A geriatric assessment within the past year revealed a Mini-Mental State Examination score of 29/30 (normal $\geq 24/30$) and full activity of daily living capability. Current medications are hydrocodone, levothyroxine, diphenhydramine, aspirin, and fondaparinux.

The patient's records show that meperidine was ordered on a routine schedule, and an additional order was to be given for breakthrough pain.

Which of the following system-level interventions will be most helpful in preventing future falls in other patients in similar circumstances?

- A. Begin collecting adverse drug event prevalence data
- B. Implement a fall-risk prediction tool for newly admitted patients
- C. Reengineer the hospital room architecture to decrease fall risk
- D. Standardize protocols for management of opiate medications

3. An 85-year-old man presents with a left hip fracture. He has been very healthy and is able to walk 4 or more blocks. He has a 3-year history of occasional chest pain that occurs less than once each month and develops only after walking too quickly. There has been no change in the severity or frequency of the chest pain and no dyspnea. Medical history is significant for a myocardial infarction 4 years ago, type 2 diabetes mellitus, and hypertension. Current medications are metoprolol, fosinopril, atorvastatin, insulin glargine, metformin, and aspirin. Blood pressure is 140/80 mm Hg, pulse rate is 60/min. BMI is 30. There is no

jugular venous distention. The lungs are clear. There are no murmurs or gallops. Serum creatinine is 1.5 mg/dL (132.6 $\mu\text{mol/L}$). An electrocardiogram shows normal sinus rhythm with Q waves in leads II, III, and aVF; nonspecific ST-T wave changes; and left ventricular hypertrophy. A chest radiograph is normal.

Which of the following is the most appropriate preoperative cardiac testing?

- A. Coronary angiography
- B. Dobutamine stress echocardiography
- C. Exercise (treadmill) thallium imaging
- D. Resting two-dimensional echocardiography
- E. No additional testing is indicated

4. An 82-year-old woman is evaluated at the hospital after tripping and falling. She fractured her right hip and needs urgent hip replacement. She reports no angina, chest discomfort, syncope, or presyncope. She has had no signs or symptoms of heart failure. Before the fall, she was active and walked daily.

On physical examination, temperature is normal, blood pressure is 164/82 mm Hg, and pulse is 96/min. BMI is 26. Point of maximal impulse is undisplaced. There is a normal S_1 and a single S_2 . There is a grade 3/6 systolic ejection murmur on examination heard at the right upper sternal border that radiates to the left carotid artery. Carotid pulses are delayed.

Transthoracic echocardiogram demonstrates severe aortic stenosis and normal left ventricular size and function. Pulmonary pressures are normal.

Which of the following is the best perioperative management option?

- A. Aortic balloon valvuloplasty
- B. Aortic valve replacement
- C. Intra-aortic balloon placement
- D. Intravenous afterload reduction (nitroprusside)
- E. Proceed directly to hip replacement

Questions are largely from the ACP's Medical Knowledge Self-Assessment Program (MKSAP, accessed at http://www.acponline.org/products_services/mksap/15/?pr31). Go to www.annals.org/intheclinic/ to complete the quiz and earn up to 1.5 CME credits, or to purchase the complete MKSAP program.