REHABILITATION OF PATIENTS WITH FRAGILITY-RELATED FRACTURES

Every fragility fracture represents a missed opportunity. While in the past clinicians had to wait for fracture to diagnose osteoporosis, we now have the means to diagnose and treat before the first fracture. And yet, today, osteoporosis causes more than 2 million fragility fractures annually. In 2005, it was responsible for some 297,000 hip fractures, 547,000 vertebral fractures, 397,000 wrist fractures, 135,000 pelvic fractures, and 675,000 fractures at other sites. Increased risk for all-cause death following hip fracture has been estimated to double in the year following fracture.

The risk for fracture rises steeply following a first fracture. Slowing bone loss and preventing falls are keys to reducing future fracture risk. Unfortunately, the majority of people who suffer a fragility fracture do not receive diagnosis and treatment for underlying bone disease. Studies show that more than three-quarters of patients discharged following hip fracture repair have not been prescribed bone preserving therapy.

The primary care clinician can play a key role in closing this gap in quality patient care, ensuring that patients with fragility fractures get the intervention they need to prevent additional fractures and, as much as possible, restore their physical function. In this issue of “Osteoporosis Clinical Updates,” we will discuss three typical fragility-fracture patients and recommendations for post-fracture patient care.

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**Postfracture Patient Care**

A *fragility fracture* is a nontraumatic bone break resulting from low-velocity impact, such as falling from standing height.

Osteoporosis is by far the most common cause of fragility fracture. (In rare cases, pathologic fracture results from cancer, infection, or other causes.) Before the advent of technology to measure bone density, osteoporosis was diagnosed solely by the presence of fragility fracture. Today, we have the tools to diagnose osteoporosis in people who have bone density low enough to place them at increased fracture risk — *before* they fracture.

Even so, fragility fracture is a serious threat to public health and one that promises to grow in the future. One in two women and one in four men over age 50 will have a fragility fracture in their lifetime.7,8 Significant risk exists in all ethnic groups.4 Experts predict that costs related to osteoporotic fractures in Hispanics will rise to an estimated $2 billion per year in 2025 (from ~$754 million in 2005).1 African Americans are at lower, but significant, risk. Five percent of African American women over 50 are estimated to have osteoporosis, while 35% have low bone mass.4

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**Activity Objectives**

*Upon completion of this CE material, the participant should be able to:*

- Develop a comprehensive plan to prevent fracture and improve physical function following fragility fracture.
- Recommend appropriate pharmacologic and nonpharmacologic agents/interventions for pain management and fracture risk reduction in patients who have recovered from osteoporosis-related fracture.
- Demonstrate principles of safe movement for patients with osteoporosis.
- Identify common physical, medical, and psychological factors that can increase a patient’s risk for falling.
- Identify the roles played by physical therapists, health educators, home health nurses, and other providers in addressing the long-term physical and psychological consequences of osteoporosis-related fractures.

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**Universal Recommendations for Bone Health and Fracture Prevention**

Measures recommended to reduce fracture risk in the general population apply equally to patients recovering from fragility fracture:

- Adequate intake of calcium
- Vitamin D sufficiency
- Weight-bearing and muscle-strengthening exercise
- Smoking cessation
- Avoidance of excessive alcohol intake

**Adequate Intake of Calcium.** Controlled clinical trials have demonstrated that the combination of supplemental calcium and vitamin D can reduce the risk of fracture. A balanced diet rich in low-fat dairy products, fruits and vegetables provide calcium as well as numerous nutrients needed for good health. If adequate dietary calcium cannot be obtained, dietary supplementation is indicated up to the recommended daily intake.

The Institute of Medicine (IOM) recommends that men age 50-70 consume 1000 mg per day of calcium and that women age 51 and older and men age 71 and older consume 1200 mg per day of calcium.9 Intakes in excess of 1200 to 1500 mg per day have limited potential for benefit and may increase the risk of developing kidney stones, cardiovascular disease and stroke. The scientific literature is highly controversial in this area.10,11,12 There is no evidence that calcium intake in excess of these amounts confers additional bone strength.

The average daily dietary calcium intake in adults age 50 and older is 600 to 700 mg per day. Increasing dietary calcium is the first-line approach, but calcium supplements should be used when an adequate dietary intake cannot be achieved.

**Vitamin D Sufficiency: BMD Maintenance & Fall Prevention.** As people age, vitamin D synthesis in the skin declines. Not surprisingly, vitamin D deficiency is widespread in older Americans. According to estimates from the third National Health and Nutrition Examination Survey (NHANES III), roughly 30% of Americans aged ≥ 60 years living in lower latitudes are vitamin D insufficient in the winter, and 26% living in higher latitudes are vitamin D insufficient in the summer.13 Studies have found that people who get limited sun exposure, such as those who are housebound or living in nursing homes, have even higher prevalence...
of vitamin D deficiency: roughly 54% of community dwellers and 38% of nursing home residents. Negative consequences of this trend are reflected in data from studies showing 65%-75% of hip fracture patients to be vitamin D deficient.

A variety of factors contribute to vitamin D deficiency in older people, including malabsorption (e.g., celiac disease) or other intestinal diseases, chronic renal insufficiency, medications that increase the breakdown of vitamin D (e.g. some antiseizure drugs), very dark skin, and obesity.

Sufficient serum 25 (OH)2 vitamin D protects the bones of older individuals through two mechanisms: maintaining BMD and preventing falls (which precede 90% of hip and wrist fractures). It is well established that sufficient vitamin D is required to absorb calcium and maintain bone density. Less well understood is the mechanism by which vitamin D benefits muscle strength and function. A growing body of evidence has emerged linking adequate vitamin D status both to general muscle strength and to enhanced function of the specific muscle fibers engaged when avoiding a fall. The result is fewer falls in vitamin D replete individuals, fewer fractures, and lower rates of all-cause mortality.

Ensuring vitamin D repletion requires testing and follow up. It may take months of supplementation to achieve target serum levels. A typical supplementation plan would consist of 50,000 IUs once weekly for 8-12 weeks until achieving 25(OH)D2 serum level of approximately 30 ng/ml. A maintenance dose of 1500-2000 IU/day can be adopted once the patient is serum sufficient. In obese individuals, patients with malabsorption syndrome, and patients on medications affecting vitamin D metabolism, a higher dose may be needed to reach and maintain target levels.

Cessation of Tobacco Use and Avoidance of Excessive Alcohol Intake. Smoking harms the skeleton as well as overall health. The NOF strongly encourages a smoking cessation program as an osteoporosis intervention.

Moderate alcohol intake has no known negative effect on bone and may even be associated with slightly higher bone density and lower risk of fracture in postmenopausal women. However, alcohol intake of three or more drinks per day increases the risk of falling and potential for fracture.

Acute Care for Fragility Fracture

Patient care following fragility fracture is a complex process involving three components: minimizing pain, reducing fracture risk, and improving function. It is most easily accomplished by a coordinated team of health professionals, often overseen by a primary care provider or, in ideal circumstances, by dedicated fracture liaison personnel.

The most common fragility fractures are those of the proximal femur (hip), vertebrae (spine), and distal forearm (wrist). Hip fractures are the most serious osteoporotic fracture. An estimated 24% of hip fracture patients over age 50 die in the year following fracture. Vertebral fractures, which can cause pain and disability, also convey a smaller but significant increase in hospitalization and mortality risk.

Hip fracture typically requires surgery to repair the fracture or replace the hip joint (proximal femur and/ or acetabulum). Fewer than half of hospitalized hip fracture patients recover their pre-fracture competence in activities of daily living. Only one-fourth regain previous levels of social functioning. At 6 months after a fracture, just 15% of hip fracture patients can walk...
across a room unaided. Consequently, 25% of those who were ambulatory before a hip fracture require long-term care afterwards.7

Vertebral compression fracture occurs when individual vertebrae become so weak that they collapse. Two-thirds of vertebral fractures are asymptomatic “silent” fractures. Vertebral fractures do not usually require hospitalization.11 However, multiple thoracic and lumbar fractures can cause spinal deformity, leading to restrictive lung disease, constipation, pain, distention, and reduced appetite.32,33 Pain, poor postural support, and altered gait can result in impairment equal to that following a hip fracture.

Treatment for acute vertebral fracture includes use of analgesics, bracing (for 2 to 6 weeks), and partial bed rest (4 days or less). Some data suggest that calcitonin, a drug approved by the US FDA for treatment of osteoporosis can be effective in treating pain of acute spinal fracture. If bed rest is recommended, a few 30-60 minute periods each day of sitting upright and walking around are valuable to avoid stiffness and bone/muscle loss. Long-term immobilization or prolonged inactivity is detrimental to bone and to the general health of the patient and should be avoided.34,35

A range of posture control braces are available, from waist-wrapping corsets to full-back braces designed to support the spine from lumbar to thoracic spine. These orthoses are custom molded and can be fitted by a physiatrist, physical therapist, or other trained clinician.

Forearm fractures include fractures of the radius, ulna, or both. If a radius fracture is not displaced, a cast or functional brace is used until there is radiographic evidence of union. Treatment varies depending on the type of fracture but may consist of splints, cast immobilization, external fixation, internal rotation, and combined internal and external fixation of fracture site for 6 weeks.16 During the cast or bracing stage, arm elevation, early mobilization, and edema-control measures are applied. If the fracture involves the ulnar bone only, casting is generally not necessary. Simple wrist splinting will usually suffice.

There is a 30% risk of reflex sympathetic dystrophy or complex regional pain syndrome in wrist fracture patients.17,18 Diminished wrist function may persist for 6 to 12 months.19 While most patients recover by one year, some experience difficulties for many years.40
**Postacute Fracture Rehabilitation**

The primary goals of rehabilitation once the fracture is repaired are to manage the patient’s pain and to prevent future fractures — through pharmacologic treatment, fall prevention, and functional improvement. A combination of medications, nutritional support, physical therapy, and behavioral approaches emphasizing safety generally yield the best results.

Primary care practitioners can most effectively work with a team of professionals that includes physical therapists, occupational therapists, nutritionists, nurse educators, and home health assistants to coordinate a comprehensive treatment plan.

**Pain Management**

Effective pain management is a cornerstone of rehabilitation from osteoporotic fractures. Pain medications range from narcotics to over-the-counter preparations with varying effectiveness and side effects. In the elderly, acetaminophen and/or low-dose narcotics administered around the clock (rather than prn for pain) can work very well. When given on a regular schedule over several weeks, this regimen allows patients to remain active, while avoiding narcotics that can cause confusion, constipation, and sleepiness. Keep in mind that some patients may require stronger narcotic pain relief.

When considering use of a pain medication, it is essential to take into account side effects such as disorientation or sedation that increase risk of falls either alone or in combination with other drugs. Because many fracture patients are medicated simultaneously for comorbid conditions, a medical history should include careful attention to potential problems of polypharmacy and drug interactions that could contribute to fall-inducing side effects.

A variety of nonpharmacologic interventions can help reduce musculoskeletal pain associated with fracture. These interventions include elevation of the distal limb to reduce edema, arm slings for upper extremity fractures, and casting of wrist and ankle fractures.

Vertebral fracture is frequently associated with chronic pain. Following healing of an acute vertebral fracture, pain generally results from changes in related tissues such as facets, disks, nerve roots, and connecting ligaments. Discomfort can also be felt in abdominal organs displaced by the kyphotic (stooped) posture that results
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from multiple fractures.

Multiple compression fractures can cause lower ribs to impinge on the iliac crest, leading to pain in the abdomen (both medially and laterally) and lower back radiating into the legs. Known as **iliocostal pain syndrome**, this condition can sometimes be improved with myofascial massage, muscle strengthening, postural training, and the use of orthotics such as wide cushioning belts or other elastic support brace.

A wide range of light-weight back braces and postural supports are available that can provide pain relief in patients with vertebral fractures by restricting spinal motion near the fracture site. They are adjustable, washable, and generally well tolerated. Even when tolerated, supports should be used only for short periods (2-6 weeks). Long-term use may be associated with weakening of spinal muscles.

The surgical procedures, vertebroplasty and kyphoplasty, can be effective in relieving pain and improving function in many vertebral fracture patients who have not found relief from other interventions. To date, data are lacking on the long-term outcomes of these techniques from large randomized controlled clinical trials, including comparison of these procedures with and without postural training. Small studies of patients up to three years follow up show enduring pain relief and functional improvement.

All osteoporotic-fracture patients should be taught proper posture and principles of safe movement. Correction of postural defects and avoidance of potentially harmful activities will help relieve chronic pain and prevent future injury. Programs of safe exercise either in the home or in a supervised setting can help minimize pain, improve medical and functional status, and reduce fracture risk.

**Drugs that Reduce Fracture Risk**

Bone mineral density (BMD) measurement is not required before initiating osteoporosis treatment in patients who have experienced a fragility fracture and have risk factors for osteoporosis. However, BMD measurement can establish a baseline for future testing and/or confirm a diagnosis and aid in selection of the most effective therapy and follow up. In addition, complete medical history, physical examination, and laboratory testing should be undertaken to rule out and/or address any underlying causes of secondary osteoporosis. For patients in which secondary causes of osteoporosis have been ruled out, an array of medications are available to help curb future bone loss and fractures.

FDA-approved drugs to reduce fracture risk include the bisphosphonates, calcitonin-salmon, denosumab, the estrogen agonist/antagonist raloxifene, estrogen/hormone therapy (ET/HT), as well as the anabolic agent teriparatide.

Efficacy studies of these medications were conducted on vitamin-D- and calcium-replete patients. Adequate intake of calcium and vitamin D is necessary to get full
therapeutic benefit from them. Calcium should come from diet first. Supplements can be used as needed to reach target intake levels (1200 mg/day in postmenopausal women). Serum vitamin D levels should be measured and supplemented to reach 30 ng/mL for maximum calcium absorption.

**Bisphosphonates.** As a class, the bisphosphonates, (alendronate, risedronate, zoledronic acid) have been demonstrated to slow bone loss and reduce incidence of fractures at the spine, hip, and total body.\(^{44-47}\) Alendronate, ibandronate, and risedronate are approved for the prevention and treatment of osteoporosis at various doses and dosing schedules, from daily to monthly, in tablet and/or injectable form (ibandronate). Data do not yet confirm that ibandronate can reduce the risk of hip and other non-spine fractures. However, ibandronate increases bone density substantially throughout the skeleton. Zoledronic acid is approved for treatment of osteoporosis and is administered as a once-yearly injectable. When used within 90 days of surgical repair of hip fracture, it was shown to reduce rates of any new clinical fracture by 35 percent.\(^{48}\)

**Calcitonin.** Calcitonin is approved for the treatment of osteoporosis in women who are at least five years postmenopausal. It is delivered as a single daily intranasal dose or subcutaneous injection. Results from a single controlled clinical trial indicated that calcitonin may decrease osteoporotic vertebral fractures by approximately 35% but does not reduce the risk of non-spine fractures. There is some evidence suggesting that calcitonin can be effective in reducing acute bone pain associated with a recent spinal compression fracture; however, the FDA has not approved it for pain management.\(^{49,50}\) Due to the availability of drugs with superior fracture reduction profiles, calcitonin is rarely prescribed in clinical practice for osteoporosis treatment. However, it is still an option for patients at high risk of vertebral fracture who cannot tolerate other FDA-approved osteoporosis therapies. Changes in the Prescribing Information for this medication are currently under FDA review.

**Denosumab.** Denosumab is a human IgG2 monoclonal antibody with affinity and specificity for human RANKL (receptor activator of nuclear factor kappa-B ligand) that inhibits the cascade of enzymatic proteins responsible for osteoclast maturation and function. It is FDA approved for postmenopausal women with osteoporosis who are at high risk for fracture (as defined by presence of multiple risk factors or history of fragility fractures) and for postmenopausal women for whom other osteoporosis medications have failed or not been tolerated.

Denosumab is administered by subcutaneous injection twice yearly in a physician’s office. Common adverse reactions include back, extremity, and musculoskeletal pain, cystitis, and hypercholesterolemia. Side-effects also include hypocalcemia, serious infections, dermatologic disorders, osteonecrosis of the jaw, and suppression of bone turnover.\(^{51}\) In the pivotal three-year FREEDOM trial of almost 8000 postmenopausal women, denosumab was shown to reduce new vertebral fractures by 68% and hip fractures by 40%, while increasing spine BMD 8.8% and hip BMD 6.4 percent.\(^{52}\) Data from a small phase II extension trial show continued and progressive gains in BMD continued for 8 years of denosumab treatment.\(^{51}\)

**Estrogen Agonist/Antagonist.** Raloxifene is an estrogen agonist/antagonist (formerly referred to as a selective estrogen receptor modulator, or SERM) approved by the FDA for prevention and treatment of osteoporosis in postmenopausal women. Raloxifene provides modest increases in bone mass and a 40%-50% reduction in vertebral fracture risk. Available data do not demonstrate reduction in non-vertebral fractures.\(^{54}\)

**Estrogen Therapy/Hormone Therapy.** Estrogen or hormone therapy (ET/HT) has been approved by the FDA for the prevention and, for select products, the management of osteoporosis. The Women’s Health Initiative (WHI) found that HT resulted in a 34% reduction in the risk of hip fracture and 23% reduced risk in other osteoporotic fractures. However, these benefits must be weighed against the WHI’s other findings: increased risk of CHD, thromboembolic stroke, venous thromboembolism, breast cancer with 5 years or more of use, and cholecystitis.\(^{55}\)

**Teriparatide.** Teriparatide is an anabolic agent developed from recombinant human parathyroid hormone. Teriparatide is administered by daily injection. It is FDA-approved for up to 2 years treatment of patients at high risk for fracture or intolerance/failure with other osteoporosis therapies. Teriparatide is approved both for postmenopausal women and for men with
A patient’s balance, reflexes, gait, coordination, and flexibility can be assessed using a variety of techniques, including the Berg Balance Scale (BBS), Functional Reach Test (FRT), and Timed Up and Go Test (TU&GT).58-60 In addition, because vision problems increase fall risk, the patient’s depth perception, visual acuity, and contrast sensitivity should be assessed and any deficits addressed.

Medications must be considered when assessing a patient’s internal environment. CNS-active drugs, diuretics, vasodilators, and antihypertensives can all place a patient at risk for falling by causing postural hypotension, dizziness, and loss of balance. When two or more medications are used in combination (polypharmacy), these side effects may be aggravated.

The external environment is more difficult to assess because a patient’s home may not be accessible, but specific home safety recommendations should be made. These include installing bright lighting in halls, stairways, and entrances; removing loose wires, cords, and throw rugs; and securing remaining rugs with double-stick tape. Patients should be advised to wear low-heeled, rubber-soled shoes and to avoid walking on waxed floors or on bare floors in socks or slippers. In the bathroom, patients should install night lights, safety grab bars, and nonskid tape in showers and bathtubs.61 Risk assessment is key to fall prevention and should be conducted by all healthcare providers.

Exercise for Functional Improvement

Research findings show well-designed exercise programs that include balance, strength and endurance training to significantly reduce risk of falls.62,63 Significant improvements are possible even in the frail elderly. Access to outside exercise programs needn’t be a barrier to physical improvement. Home-based programs of low-intensity back exercises have been observed to significantly increase strength, function, and quality of life in patients with fragility fracture.61 Physiatrists, medical doctors with specialization in physical medicine and rehabilitation, can identify precautions that an individual patient should take to avoid injury and medical complications related to exercise.

Weight-bearing exercise, which increases skeletal loading, has been shown to increase bone density (about 6% in spine).64 Caution is necessary to prevent fracture

### Major Risk Factors for Falls

**Medical risk factors**
- Advanced age
- Arthritis
- Female gender
- Poor vision
- Urge urinary incontinence
- Previous fall
- Orthostatic hypotension
- Impaired transfer and mobility
- Medications (analgesics, anticonvulsants, psychotropics)
- Malnutrition (vitamin D deficiency, insufficient protein)

**Neuromuscular risk factors**
- Poor balance
- Weak muscles
- Gait disturbances
- Kyphosis
- Reduced proprioception

**Environmental risk factors**
- Low level lighting
- Obstacles in the walking path
- Loose throw rugs
- Stairs
- Lack of assistive devices in bathrooms
- Slippery outdoor conditions

**Psychological risk factors**
- Anxiety and agitation
- Depression
- Diminished cognitive acuity
- Fear of falling
The slow-motion martial arts exercise, Tai Chi, has been shown to improve strength and balance, reducing fall risk by as much as 47 percent. This suggests that the exercise does not have to be strenuous to be effective in preventing falls. One large clinical study found that simply walking regularly reduced hip fracture by 30 percent.

**Exercise for Hip Fracture.** Following a hip fracture, physical therapy and exercise can improve transfers (e.g., from bed to chair), gait, leg strength, flexibility, and balance. Most hip fracture patients benefit from a full-body exercise program tailored to their initial condition with guided progression as strength improves.

Physical therapists can teach hip fracture patients the proper and safe use of assistive devices such as canes and walkers and, if safe, assist the patient in progressing from walkers to canes to unaided walking. Orthotic hip protector pads can be useful in reducing fracture risk in individuals at high risk for falls.

**Exercise for Vertebral Fracture.** Following a vertebral fracture, improvements can be made in back, shoulder, and abdominal strength, as well as flexibility, balance, and posture. While spinal extension exercises are especially valuable, comorbid conditions such as spinal stenosis, or narrowing of the spinal canal, may limit their use. Forward bending of the spine, especially in combination with twisting, should be avoided. Unsupported sitting for upper extremity weight training should also be avoided because slumping forward puts high loads on the spine.

**Exercise for Wrist Fracture.** Following wrist fracture, bone healing may take 6-8 weeks, while rehabilitation usually takes 12 weeks. Maximum recovery can take as long as 10-16 weeks.

Rehabilitation for a wrist fracture may include the following steps:
- Isometric contractions of the forearm muscle group while the arm is immobilized.
- Active and passive range-of-motion exercises using all joints of the involved extremity, especially the shoulder, elbow, and hand.
- After cast/splint removal, gradual pronation (turning palm downward), supination (turning palm upward), flexion, and extension exercises with forearm fully supported are needed to regain full range of motion.
- Progressive resistive and grip strengthening exercises, such as ball squeezing.

**Long-Term Management**

Long-term fracture rehabilitation should focus on motivating the patient to continue exercise and medication interventions, preventing falls, addressing psychosocial consequences of fracture, and monitoring bone health so that any necessary adjustments to treatment can be made.

Benefits of exercise and physical therapy do not persist for long once the activity is discontinued. For the most
part the same is true of pharmacologic approaches to bone loss. It is essential that patients are followed to ensure that they are continuing their medications and programs of physical activity.

There are many successful strategies for motivating patients to participate in exercise programs, including providing transportation, organized group classes, follow-up phone calls after missed classes, and low-cost or free classes. Patient education is also helpful because it gives the patient a clear sense of the benefits of exercise to his/her health, addresses any fears the patient has concerning fracture risk associated with exercise, and reassures the patient that he/she is capable of succeeding in the program. Working with a multidisciplinary team, primary care providers are in a good position to coordinate and oversee the components of a successful management plan.

Osteoporosis is a disease with grave social and psychological consequences. Deterioration in functional status, independence, social relationships, and emotional well-being are common following fracture and contribute significantly to reduced quality of life. As osteoporosis worsens and disability becomes more evident, individuals find it difficult to remain socially active. They often lose social roles that have given them meaningful and productive lives.

Depression and fear of falling are common psychological consequences of osteoporosis. Both can lead to further isolation, inactivity, and elevated fracture risk. Fortunately, these conditions can be successfully diagnosed and treated. When a diagnosis of depression is made, effective management includes patient education, treatment, and ongoing monitoring.

Psychotherapy can be effective in many patients. However, when depression or anxiety is severe, most experts believe that pharmacotherapy is required rather than psychotherapy or counseling alone. Selective serotonin reuptake inhibitors, or SSRIs, frequently prescribed for treatment of depression, have been associated with bone loss at the hip. In addition, because some antidepressant/anxiolytic medications can cause dizziness or loss of balance, patients on these drugs should be monitored carefully to avoid increasing fall and fracture risk.

Several approaches have proven effective in improving the psychosocial condition of osteoporosis patients,
including support groups, targeted medical education, and self-management strategies.

Support groups bring together people experiencing similar difficulties, helping to restore social interaction and self-confidence. Targeted education programs teach patients specific coping strategies and pain relief skills for managing their osteoporosis. Self-management strategies teach patients with chronic diseases to take responsibility for the day-to-day management of their disease. As a result, such patients feel more in control and report overall improvement in symptoms.72

Assessment of patient fear of falling related to specific functional activities, such as walking on icy surfaces, rising from chairs, or climbing stairs after dark can be useful when designing task-specific interventions tailored to individual patient needs.71

**Safe Movement: Exercise, Daily Activities, & Recreation**

For patients with spinal fractures, safe movement means using the body in ways that minimize loads on the spine and prevent loss of balance and falls. The primary goal is to prevent vertebral fractures. In patients with chronic pain after vertebral fractures, proper trunk alignment, bracing, and safe movement can also minimize pain.74

**Exercise.** Exercises that vigorously and repeatedly flex or rotate the spine, or that subject the spine to weight-resistance, should be avoided. These include calisthenics (sit-ups, toe touches) and some exercise equipment. For instance, rowing machines and bicycles with reciprocal arm movements, and weight-training equipment that forward flexes, extends, or rotates the trunk beyond neutral should be avoided. Biceps curl machines that can also induce dangerous trunk flexion, particularly if a person is either too small or weak to lift the lightest weight, or doesn’t maintain good trunk alignment. In general any equipment that requires resistance against the spine is usually not safe.

One study has documented vertebral fracture in women with established osteoporosis doing different types of trunk calisthenics. A high percentage (89%) of the women performing flexion (bending) exercises had a new clinical vertebral fracture over an average 1.4 to 2 years of follow-up.75

Although it is important to maintain flexibility and range of motion in both flexion and rotation, for safety these exercises should be performed with the spine unloaded (i.e., lying down) and with attention to a slow, easy quality of movement.

**Daily Activities.** For most people, bending and twisting the spine are habitual movement patterns. Physical therapists can teach patients new methods for lifting, reaching, self-care (brushing teeth, washing hair), doing housework, gardening, and performing home maintenance. T ermed “good body mechanics,” these movement patterns involve maintaining an erect spinal and head alignment while flexing at the hips and knees when the body must be lowered or must come forward to perform a task (rather than bending at the waist or leaning, for example).

When using the body in this way, the large leg muscles perform the work instead of the relatively small and short paraspinal (back) muscles. Lifting heavy or awkward objects should also be avoided. The use of assistive devices such as long-handled reachers, shoe horns, and sock donners, also reduce the need for trunk flexion and the risk for falling.

**Recreational Activities.** Advising patients regarding safety of specific activities is not entirely straightforward. Advising everyone with established osteoporosis to stop these activities could result in inactivity, leading to premature bone loss, muscle mass and strength loss, increased risk of falling, and poor quality of life. Activities at the extremes of potential skeletal loading are easy to categorize as don’t do’s (bungee jumping, sky diving). But many activities frequently enjoyed in retirement (golf, bowling, tennis) are difficult calls and, therefore, best made on an individual basis, taking into account bone density, fracture history, fitness level, muscle strength, coordination, balance, and risk tolerance.

**Patient Cases: Improving Outcomes for Patients After Fragility Fracture**

In the following case studies, we will discuss issues related to rehabilitation following fragility fracture in typical patients.

**Case 1: 65-Year-Old Woman with Spinal Fracture**

The first patient we will discuss is a 65-year-old woman
who sustained a thoracic compression fracture four weeks earlier. She is referred for back pain so severe that it makes it nearly impossible to complete daily self-care and household activities. The patient is house-bound and cannot do her own shopping. She reports having trouble cooking and so her diet is limited to meals that can be prepared quickly.

**How can the patient’s bone health and fracture risk be assessed?**

First, to rule out any underlying diseases that may be causing the bone loss, a thorough history and physical examination is completed. The physical examination focuses on identifying any postural abnormalities, muscle weakness, and joint stiffness and/or immobility. All of these conditions contribute to poor balance and increase fall risk. In addition, the patient’s visual and mental status are assessed for deficits that put her at present risk and may have contributed to her original trauma: a simple fall in her home.

**What labs should be done?**

Chemistry profile, CBC, TSH, vitamin D, celiac panel, PTH level, and serum protein electrophoresis are ordered to look for potential causes of secondary osteoporosis. If test results warrant, a 24-hour urine calcium assessment will be performed. With this ruled out, the patient’s primary osteoporosis and factors that contribute to the patient’s disease, discomfort, and functional deficits can be addressed.

<table>
<thead>
<tr>
<th>Product</th>
<th># of Servings/d</th>
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<tbody>
<tr>
<td>Milk (8 oz.)</td>
<td>X 300 =</td>
</tr>
<tr>
<td>Yogurt (6 oz.)</td>
<td>X 300 =</td>
</tr>
<tr>
<td>Cheese (1 oz. or 1 cubic in.)</td>
<td>X 200 =</td>
</tr>
<tr>
<td>Fortified foods or juices</td>
<td>X 80 to 1,000** =</td>
</tr>
</tbody>
</table>

Subtotal =

Step 2: Total from above + 250 mg for non-dairy sources +250 =

Total Calcium =

* About 75 to 80 percent of the calcium consumed in American diets is from dairy products.

** Calcium content of fortified foods varies.

**Figure 1. Patient-friendly calcium estimator.**

A DXA scan is ordered to determine the patient’s BMD. Her vertebral fracture is sufficient for a diagnosis of osteoporosis. A DXA will confirm this diagnosis and provide critical additional information regarding the patient’s hip bone density.

The patient’s femoral neck T-score is -3.0, confirming the diagnosis of osteoporosis (diagnostic threshold -2.5).

**What pharmacologic and nutritional interventions would be appropriate for this patient?**

The patient is counselled to add calcium-rich foods to her diet. She is given a calcium estimator to help her assess her daily intake (see page 12). She is instructed to take over-the-counter supplemental calcium as need to get her daily intake up to a target of 1200 mg/day. In addition, she is instructed to take over-the-counter supplemental vitamin D3(1000 IU/day). Once stable levels of calcium and vitamin D are established, the patient is prescribed an oral bisphosphonate. (The patient has no history of gastrointestinal disease and no pending dental extractions.)

**Is the patient’s pain simply the result of the healing of an acute vertebral fracture?**

Possibly; however, it may not be. Pain from an acute spinal fracture usually resolves with stabilization and healing of the fracture within six to eight weeks of fracture. The patient’s pain could also be caused by postural changes that stem from the healing fracture. It could be aggravation of microfractures elsewhere in the spine brought on by forward-leaning posture (kyphosis) that results from collapsed vertebrae, or it may be a sign of continuing compression of the original fracture. The patient is asked under what conditions the pain arises. She reports that the pain starts about an hour after she wakes up in the morning and while she is working around the house, both sitting and standing. She reports that the pain goes away almost completely when she lies down flat.
What is recommended regarding bed rest?
The situation in which a patient feels excruciating pain when upright and little to none when lying down is a primary contributor to loss of independence and admission to a nursing home. It is critical that the patient be encouraged to remain active and upright. Bed rest after fracture is not recommended for more than a few days, during which pain management is optimized. This should be followed by four to six weeks of bracing and training for safe transfers and ambulation. The goal is to get the patient out of bed with as little pain as possible and to increase her tolerance to upright activities. The patient should be encouraged to lie flat every hour for five to ten minutes (no longer) during her daily activities at home. This pain-relief break will help to prevent the pain from reaching unbearable levels.

What can be done to help the patient avoid additional injury?
It usually takes six to eight weeks to heal a vertebral fracture from time of onset. During this time, attention to correct posture and safe movement in activities of daily living is essential to avoid disturbing the healing fracture. The patient can be referred to a physiatrist and physical therapist at the time of fracture for pain management, bracing, and postural training. A physiatrist and/or physical therapist can also teach the patient safe movement strategies and strength-building exercises that can help her avoid fracture in her daily activities and improve her mobility and functioning at home. At-home physical therapy may be beneficial.

What are the best options for pain management?
When asked what she has taken for the pain in the past, the patient reports that she has avoided any form of pain medication because they made her dizzy and light headed. In view of this, and given the patient’s lack of gastrointestinal risk factors, the patient is prescribed a nonsteroidal anti-inflammatory analgesic that is not known for having sedative or gastrointestinal effects. The patient is asked to report back on the effectiveness of this medication in controlling her pain and advised her that a narcotic may be necessary for short-term relief.

What follow-up should be undertaken?
If the pain continues longer than six weeks, despite consistent pain medication, postural training, bracing, and activity modification, it could be the result of continued wedging of the vertebral bodies as additional microfractures precipitate collapse. Repeat x-ray of the back would indicate if additional fractures have occurred that require stabilization. MRI is more sensitive but costly.

What are options if x-ray shows progressive fracturing and deformity?
This patient might be a good candidate for kyphoplasty or vertebroplasty to control pain and limit deformity. Kyphoplasty and vertebroplasty are not effective on old fractures. MRI of the back would make it possible to assess the age of the fracture (edema present on MRI scan indicates active healing). When MRI is not possible, CT scan and dual-plane x-ray may be used. MRI with STIR images is the gold standard for evaluating new fractures in adjacent vertebrae, fracture status prior to kypho/vertebroplasty, ongoing healing in an existing fracture, and nerve impingement at the site of  

Assessment of Patient with a Low-Impact (Fragility) Fracture

Evidence-Based Guideline Recommendations#
- Consider all adults with a history of vertebral fracture, hip fracture, proximal humerus, ankle, pelvis or distal forearm fracture at higher than average risk for a future fracture.
- Review lifestyle risk factors for osteoporosis.
- Discuss adequacy of total calcium and vitamin D intake.
- Address home safety, fall prevention and specific exercises for muscle strength.
- Consider bone density testing in patients with fractures who are willing to accept treatment.
- Consider all men* and postmenopausal women with low-impact (fragility) fracture as potential candidates for pharmacologic and physical medicine treatment.
- Consider women over age 70 with prior fracture as candidates for osteoporosis therapy even without bone density testing.

*Although the best data is on postmenopausal women, there may be a similar risk in men, and the guideline work group is including men in this guideline recommendation [Low Quality Evidence].

Refer to the original guideline document for more information.

While we lack data from large long-term randomized, controlled studies on its effectiveness, kyphoplasty/vertebroplasty have shown promise in reducing or eliminating pain in patients with mild spinal deformity. Review of postural and exercise guidelines should be provided post-procedure.

Case 2: 80-Year-Old Woman with Multiple Vertebral Fractures and Chronic Pain

A 80-year-old woman is seen for chronic pain of two years duration. She developed several thoracic fractures over the preceding 10 years causing her to lose 7” in height. She has frequent nonfrontal headaches, as well as shoulder and mid-thoracic pain. She notes abdominal pain when constipated and has frequent lateral lower-quadrant pain when working in the house. She has shortness of breath with limited exertion and a tendency to lose her balance when walking.

What can be done for this patient?
The patient’s bone loss can be slowed with the use of drugs, and her levels of calcium and vitamin D can be optimized through diet and supplements.

Will antiresorptive drugs restore the patient’s function?
Although antiresorptive drugs can slow her bone loss and reduce risk of future fractures, her functional capacity cannot be fully restored by either medication or rehabilitation. It can be much improved, however. This patient typifies what happens if bone loss is not caught and treated in time. Her now-severe debility might have been prevented. With the severity of her spinal kyphosis, she is so bent over that she is at risk for pulmonary complications because she is no longer able to expand her rib cage. The patient’s shortness of breath is a worrisome sign. Her pulmonary function should be monitored closely and she should be considered for pulmonary rehabilitation to improve lung capacity, physical function, and exercise endurance.

What is the cause of her abdominal and intestinal disorders?
A patient who has lost 7” in height has such severe deformity that she is unable to reach, to bend over, to perform the activities of daily living. This is truly devastating, physically and psychologically. In all likelihood,
the patient’s abdominal cavity has been compressed by her upper torso to such a degree that her abdomen now protrudes, causing the additional discomfort of chronic constipation.

**What can be done to relieve the patient’s lateral abdominal pain?**

Her lateral abdominal pain may be exacerbated by iliocostal impingement syndrome, in which her lower ribs are actually sitting on her iliac crest. The pain of this condition can be improved in some patients with a soft, wide belt that separates the ribs from the iliac crest and postural training to engage muscles that extend the spine and lift the rib cage.

Pain medications in the form of topical anti-inflammatory patches and/or localized injections may also be of benefit. In addition, myofascial release performed by a physical therapist or other trained professional can help. Myofascial release is a manual technique that uses gentle sustained pressure to stretch connective tissue surrounding muscles that has become constricted due to overuse, trauma, or inactivity.

**What can be done to address the patient’s chronic headache pain?**

Her headache pain is probably the result of the cervical spine and shoulder muscle strain of fighting gravity to hold her head up, unsupported by her collapsed vertebrae. At this stage of spinal collapse, it may be beyond the capacity of the musculature to hold the spine in an upright posture. Physiatric evaluation and physical therapy may help in determining appropriate bracing and treatment options to improve balance and range of motion.

**Is this patient at risk for depression?**

Without a doubt. Because of her pain, disfigurement, loss of independence, and poor prognosis, this patient is at significant increased risk for depression, anxiety, and fear of falling. It is essential that her psychological health be assessed and that any diagnosed depression be treated, either through counseling or pharmacologic means or both.

**Can this patient be helped by rehabilitation?**

Even in the most severe cases a patient’s quality of life can be improved by pain relief, good physical therapy, and a positive attitude. Although rehabilitation is unlikely to restore the patient’s ability to live unassisted, we can strive to maintain her level of function, control her pain, and address her psychological needs.

**Case 3: 70-Year-Old Woman with an Acute Hip Fracture**

The third patient we will discuss is a 70-year-old woman with an acute hip fracture. She was hospitalized four days for the acute fracture, during which time she received inpatient rehabilitation on the surgical unit. She has been ambulatory to a limited degree, walking less than 20’ with the aid of a walker. She is transferred to an in-house rehabilitation unit.

**What can be done to help ensure that rehabilitation begun in the hospital and rehabilitation units continues once the patient gets home?**

Current pressures to discharge patients earlier from hospitals and rehab facilities after hip fracture may place the patient’s rehabilitation gains in jeopardy in the long term. It is essential that efforts be made to coordinate the various aspects of a patient’s care to ensure continuity. Working closely with a team of health care professionals (which usually include physiatrists, physical therapists, social workers, home health nurses, and occupational therapists) is necessary to accomplish this transition.

**Should the patient continue her program of physical rehabilitation right away when she gets home or can she take a break?**

Gains made in recovering mobility and strength are lost rapidly once exercise has been discontinued. Critical health risks for patients recovering from hip fracture are closely related to bed rest, such as pulmonary complications and stroke. As a result, getting the patient active and keeping her active are essential to her functional recovery and long-term survival. In patients who return to community living, transition to outpatient rehabilitation is common once home health personnel have established safety and adequate assistive devices and/or equipment in the home.

**What are additional concerns for the patient once she gets home?**

Bone health maintenance and prevention of future fractures are both critically important. To this end the patient is prescribed bisphosphonate therapy and
counselled to increase her dietary calcium, supplementing as needed to reach 1200 mg/day and 1000 IU/day of vitamin D.

Fall prevention in the home will be critical to the long-term health of this patient. While 90% of fractures result from falls, fractures aren’t their only negative outcomes. Patients who fall can suffer herniated discs, severe neck or back pain, sprained ankle, subdural hematoma, and/or sacroiliac joint injury. Many of these conditions are painful, requiring narcotic pain relief, further increasing risk of falls.

Ideally, before a patient is discharge to home from an inpatient rehabilitation facility, a trained domestic occupational therapist or other professional conducts a thorough home safety assessment and recommends any necessary changes, such as addition of grab bars in the shower, removal of tripping hazards, and improvement of lighting.

**What can be done to prepare family members for the transition from hospital to home?**

While the patient is still at the inpatient rehab facility, the patient’s caregiver (husband) can be trained how to safely assist in her activities of daily life without injuring himself in the process. Because he will be with her 24 hours a day, he will often be the only caregiver and so would need training in assisting with activities of daily living such as transfers to and from bed, bathing, and toileting. The patient may also benefit from hip protector pads, which significantly reduce fracture risk associated with falls and are available from a variety of manufacturers.

**What long-term issues should be followed?**

Progress of the patient’s healing should be monitored. If she continues to have pain in the hip after 6-12 weeks, she may have experienced additional stress fractures or loosening of orthopedic hardware and should undergo MRI if x-rays are not conclusive. Evaluation of postoperative problems will depend on what surgical treatment was used.

The patient’s long-term participation in safe activities can be encouraged through referral to a community-based exercise program. If transportation to a class is a problem, community resources can be called upon for assistance.

**Summary**

Fracture is a frequent and often life-altering consequence of bone fragility. Working in coordination with a multidisciplinary team, primary care providers can help ensure timely and effective intervention, which can make the difference between recovery and chronic disability, even death. Goals of management for acute fractures include stabilizing and repairing fracture. Following this, the goals are minimizing pain, reducing fracture risk through medication and nutritional support (supplementation if needed), fall prevention, and functional improvement. As with any chronic disease, long-term management of osteoporosis requires continual monitoring and follow-up to ensure that interventions are meeting outcome goals. Regular bone density testing, fall risk assessment, and psychological evaluation should be conducted so that modifications to treatment can be made when indicated.

**Note:** The reader is directed to *Clinician’s Guide to Prevention and Treatment of Osteoporosis and Boning Up on Osteoporosis*, published by the National Osteoporosis Foundation, for a discussion of condition-specific safe exercises and practical guidelines for safe movement in activities of daily living.

**References**


Managing Post-Fracture Pain

Recovering from broken bones can be a long and painful process. Pain can continue long after a fracture heals. Ongoing chronic pain can make it hard to sleep; it can make people irritable or depressed. This, in turn, can make the pain feel worse. Many patients do not readily share information about their pain. Healthcare providers can use direct questions about sleep problems and difficulties in daily activities to elicit descriptions of pain. Healthcare providers who identify patients with chronic pain can pursue one of many effective strategies for pain control and management.

Approaches that have been shown to improve pain associated with osteoporosis-related fracture include:

- **Prescription and over-the-counter (OTC) medications.** OTC medications such as aspirin, acetaminophen (Tylenol®), ibuprofen (Advil®, Motrin®) or other nonsteroidal anti-inflammatory medicines, can help manage pain. These medications can have side effects, especially if taken at high doses or for a long period of time.

- **Application of heat or cold.** A cold compress or a bag of frozen peas can be applied to the injured area. Warm towels and heating pads can also provide some relief. Do not use either of these for more than 15 - 20 minutes at a time.

- **Transcutaneous electric nerve stimulation (TENS).** This is a method to reduce pain with electrical impulses. A TENS unit sends a mild current traveling through electrodes into the body. Patient may feel tingling or warmth. A treatment lasts from 5-15 minutes.

- **Acupuncture.** The traditional Chinese technique of precise penetration of the skin with fine steel needles has been studied extensively for its therapeutic potential. Recent metanalysis suggests a benefit for relief of chronic pain.* Acupuncture is gaining acceptance in this country as a way to reduce pain. Some health insurance companies offer coverage or discounts for acupuncture.

- **Biofeedback.** This type of therapy uses electronic instruments to measure body functions and then feed that information back to the patient. A biofeedback specialist uses this information to teach the patient to control involuntary body responses, such as blood pressure or heart rate. It can also be helpful for managing pain.

- **Behavior modification.** This is a technique to change habits, behaviors, and emotions that can result from ongoing pain. It may include rewards for increasing physical activity, improving diet, or making other lifestyle changes.

- **Massage.** Broken bones can cause pain and tension in the muscles surrounding the fracture. Gentle massage of these muscles may help to decrease the pain in these muscles. It’s important to work with a qualified massage therapist trained to practice on fracture patients and patients with osteoporosis.

- **Physical activity.** Being active is a natural way to reduce pain. Through exercise, the body releases endorphins that can relieve pain and boost mood. Exercise also has many other health benefits. Patients recovering from osteoporosis-related fracture can frequently benefit from working with a physical therapist.

- **Relaxation techniques.** Several different relaxation techniques have been shown to help people release muscle tension and shift attention away from pain. Some examples include deep breathing, progressive muscle relaxation, and guided imagery. Patients can learn and practice these and other relaxation techniques with the aid of CDs, videos, books and classes, as well as trained professionals.

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