



NATIONAL
OSTEOPOROSIS
FOUNDATION

HEALTHCARE PROFESSIONALS TOOLKIT



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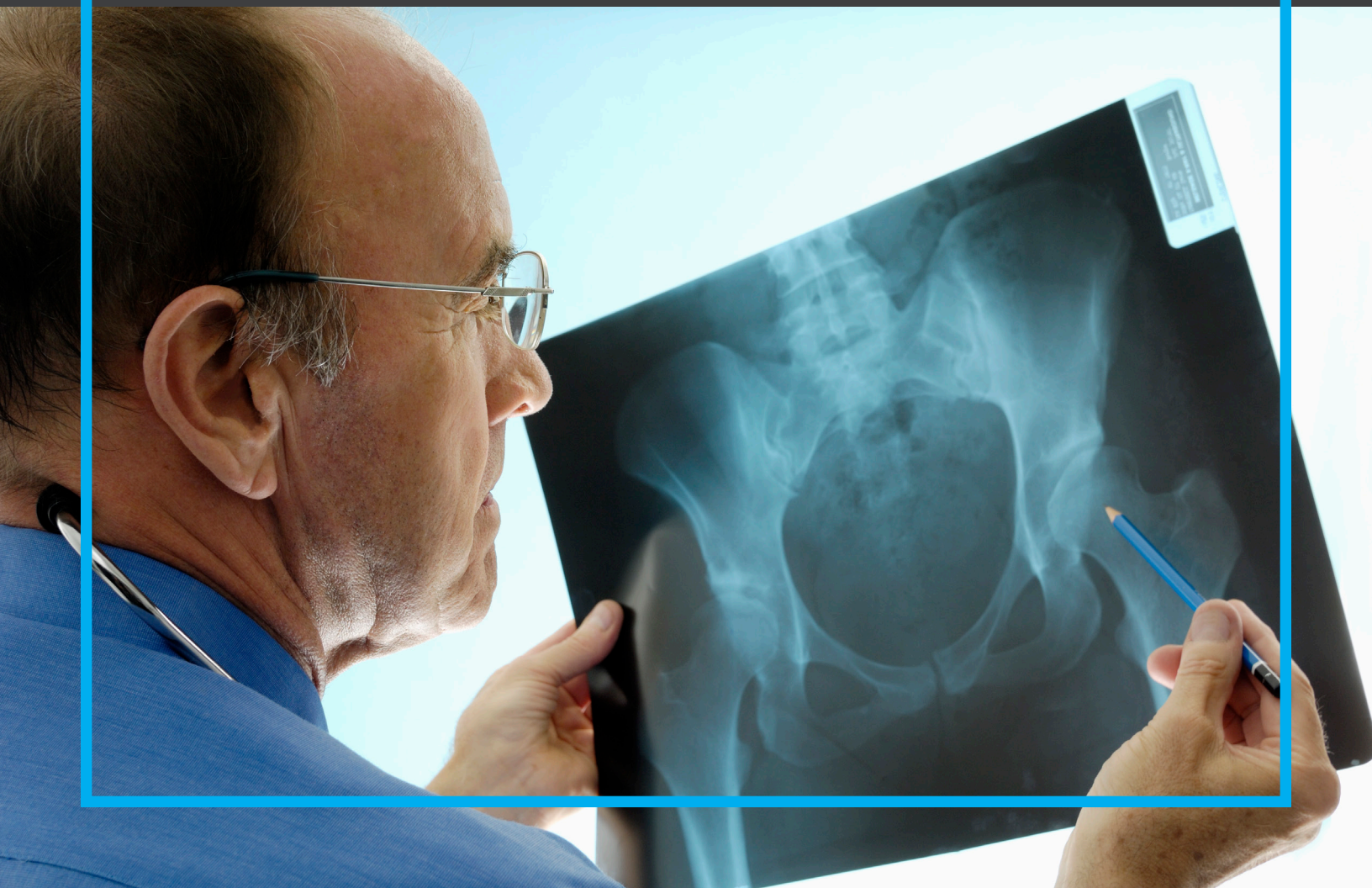
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PRIMARY CARE TOOLKIT

Despite prior strides in osteoporosis detection and treatment, hip fracture rates have begun to increase after declining for decades.¹ In the U.S. this reversal has been driven by reduced Medicare reimbursement for densitometry, with resulting restricted access and fewer patients being diagnosed and treated. Globally, a significant drop in hip fracture rates had been seen between 2002 and 2012, but this trend has been reversed. If this pattern had continued to the present day, we would have seen an estimated 11,000 fewer hip fractures between 2013 and 2015.

The devastating consequences of osteoporotic fractures are well known: pain, disability, and loss of independence.² Hip fracture is the most deadly, killing one out of five hip fracture patients within a year of injury and necessitating long-term care in one out of three. Of the 1.8 million fractures suffered in the U.S. every year, most are due to low bone density or osteoporosis. Ideally, bone loss can be detected and treated before fractures occur. However, this usually does not happen. In fact, the majority of hip fracture patients are discharged without a diagnosis of osteoporosis and no antifracture treatment is provided.³

The aim of the Primary Care Toolkit is to increase the identification, assessment, and treatment of patients who are at risk for fractures by physicians and other healthcare professionals in primary care practice. As the patient's "medical home," primary care is the ideal setting for implementing and overseeing these evidence-based fracture prevention strategies.



SKELETAL DEVELOPMENT AND PEAK BONE ACQUISITION

The human skeleton is a dynamic organ responsive to biologic and mechanical forces. In infancy and childhood, skeletal mass increases rapidly, due to gains in length at growth plates and girth at cortical surfaces. During adolescence, skeletal growth accelerates, which is of particular importance for girls, who acquire 40-50% of their total skeletal mass during teen years. Acquisition of bone mineral lags a little behind matrix formation, resulting in transient periods of relatively low bone mineral density (BMD) in growing children and teens. Both genders acquire up to 90% of their adult bone by age twenty. Susceptibility to osteoporosis later in life is largely determined by the bone mineral density achieved in adolescence (peak bone mass) and to a lesser degree by genetic factors, with contributions from nutrition, endocrine status, physical activity, and health during growth.

The mature skeleton is maintained by a tightly controlled two-phase remodeling/repair cycle of bone turnover. In the first phase, osteoclasts digest injured bone on damaged surfaces. In the second phase, osteoblasts secrete bone substrate material (osteoid) and form new bone, which is then mineralized over weeks and months that follow. In a healthy adult, the balanced cycle of resorption and formation maintains skeletal equilibrium. However, aging and other conditions can disrupt the bone remodeling cycle, leading to loss of bone mineral and skeletal fragility. Deterioration is not uniform throughout the skeleton. Excessive mineral loss and disordered bone formation occur at particular skeletal sites depending on many factors that include gender, age, and secondary medical conditions. In part, this asymmetry depends on skeletal distribution of distinct bone phenotypes and in part on skeletal response to biochemical and mechanical stressors.

TYPES OF BONE

Bone is made up of two basic compartments: trabecular bone and cortical bone. Trabecular bone (also called cancellous bone) is the sponge-like matrix at joints, the ends of long bones, and inside vertebrae; while cortical bone is the hard, compact outer layer characteristic of long bones.

Trabecular bone has a much higher ratio of surface area to mass than cortical bone, which facilitates the release of metabolically necessary ions into circulation during the resorption process. Aging and other conditions can speed up the bone turnover cycle. This gives the resorption phase an advantage over the slower formation phase. The result is a gradual loss of bone tissue, disproportionately affecting trabecular bone tissue, the site of most remodeling activity.

MECHANISMS OF SKELETAL DETERIORATION

Figure 1 shows the changes within trabecular bone as a consequence of age-related bone loss. Individual trabecular plates of bone are lost, leaving an architecturally weakened structure with significantly reduced mass. Increasing evidence suggests that rapid bone remodeling (as measured by biochemical markers of bone resorption or formation) increases bone fragility and fracture risk.

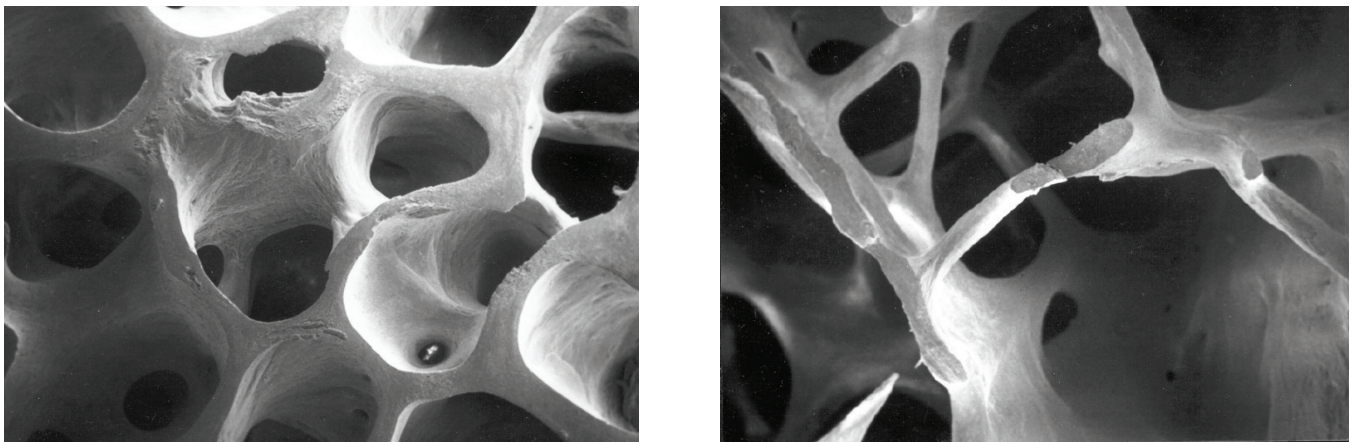


FIGURE 1. Micrographs of Normal vs. Osteoporotic Bone⁴

(From: Dempster, DW et al., with permission of The American Society for Bone and Mineral Research.)

THE MUSCLE-BONE CONNECTION

Bone responds dynamically to stresses exerted on it by initiating the bone turnover process. Stresses can be compressive, pushing against bone when it is loaded; or resistive, pulling against bone when attached muscles contract. This is not a problem for healthy young people whose muscle is strong and bone is up to the challenge of the mechanical forces placed upon it. However, problems can arise with aging, when bone and muscle mass decline in tandem. The resulting triad of coexisting low BMD, low muscle mass, and elevated risk for falls is strongly associated with fracture incidence, disability, and premature death. Exercise reduces this risk by strengthening both muscle and bone. In fact, exercise is the only intervention shown to improve fall risk and physical function in populations with age-related muscle loss, or sarcopenia.

Sarcopenia, the age-related decline in muscle fiber size and number, commonly occurs in older people, especially those with activity restricted by illness or injury. Weaker muscles increase risk for fall-related fractures. In addition, because bone strength is dependent on the pull of muscles and tendons, weaker muscles contribute to weaker bones.

EFFECTS OF BONE LOSS ON THE SPINE

Spinal vertebrae are the most commonly broken bones in older adults, and the bulk of these are vertebral compression fractures, or VCFs. In the United States, it is estimated that individuals experience 550,000 VCFs annually the vast majority of which do not come to clinical attention. For the spine to remain healthy, its complementary intervertebral disks, muscles, tendons, and ligaments must be sufficient in strength and functionality to sustain the forces exerted on them. Functional inadequacy in one structure spurs compensatory over-functioning in another, often resulting in acute or chronic pain. An example of this is when vertebral collapse triggers spasm of paraspinal muscles that must now work harder to hold the body erect.

Although compression fractures can occur in any vertebrae, VCFs occur most commonly at the midthoracic (T7-T8) and thoracolumbar (T12-L1) vertebrae in both men and women. This is the region under greatest stress, located at the apex of the thoracic spinal curve and the transition point between the thoracic and lumbar spine.

In untreated osteoporosis, one VCF usually leads to another. In the case of vertebral fracture, 50% of patients have another within three years. As VCFs accumulate, resulting postural changes reduce space in the thoracic and abdominal cavities, eventually causing a variety of cardiovascular, pulmonary, neurologic, and digestive disorders in addition to chronic pain. Even in the absence of VCFs, weak back muscles are associated with progressive spinal curvature (hyperkyphosis), which is itself linked to morbidity and mortality in older women.

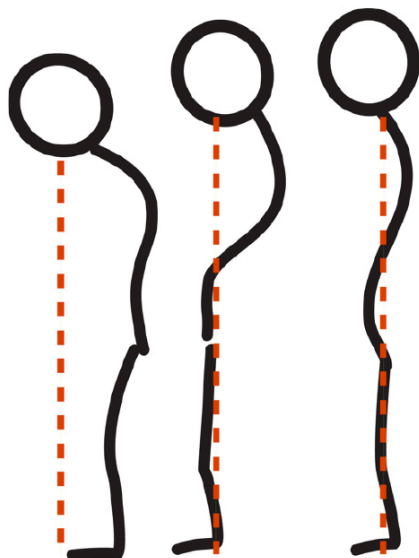


FIGURE 2. Biomechanical modeling has demonstrated spinal compressive load to be greatest in uncompensated hyperkyphotic posture (left), in which the center of mass is anterior to the spinal column. It is improved by posterior pelvic tilting in compensated posture (center) and most effectively countered by congruent posture in which pelvic tilt is accompanied by increased lumbar curvature (right). (NOF. Fragility Fractures: The Impact of Movement, Exercise, and Body Mechanics. *Osteoporosis: Clinical Updates*. 2018.)

RED FLAGS: SIGNIFIERS OF HIGH RISK FOR FRACTURE

Identifying patients at highest risk for fracture enables the clinician to intervene while there is still time to preserve bone health and avoid the disability and premature mortality that can result from osteoporosis-related fractures. Many diseases, conditions, behaviors, and medical treatments are associated with increased risk for bone loss and fractures (See table on page 6). These risks are cumulative and dose dependent: the more risk factors and/or the more of a particular risk factor a person has, the higher the risk for fracture.

Among these risk factors, several are highly predictive of *imminent* fracture risk. Patients with these red flag risk factors need urgent evaluation and intervention.

- **Female gender:** Women are twice as likely to have osteoporosis than men. BMD declines earlier and more in women than men: 0.96% per year in women aged 65-69 years as compared with 0.82% per year in men aged 74-79 years.⁵
- **Recent fracture:** Recent fracture is strongly associated with subsequent fracture, particularly in the year following.^{6,7} Hip fractures are associated with 2.5-fold increased risk of other major osteoporotic fracture.⁸ Vertebral fractures with up to 5-fold higher risk for additional vertebral fractures and 2- to 3-fold greater for fractures at other sites. Risk increase following a wrist fracture is comparable to that following hip or spine fracture in the ensuing year.⁹
- **Long-term high-dose glucocorticoid use:** Long duration and continuous pattern of GC use demonstrated a significant 5-fold increased risk of hip and 5.9-fold increased risk of vertebral fracture. The combined effect of higher dose, longer duration, and continuous pattern further increased RR estimates to 7-fold for hip and 17-fold for vertebral fractures.¹⁰
- **Advanced age:** Fracture risk goes up with every year of age.
- **Very low BMD:** Fracture incidence increases as BMD decreases.
- **Falls in the past year:** Falls preceded 95% of hip fractures and 85% of all fractures in older adults. Approximately 30% of falls result in an injury that requires medical attention, with fractures occurring in approximately 10%.¹¹

Table 1. Risk Factors for Fractures*(Reprinted from NOF. Clinician's Guide to Prevention and Treatment of Osteoporosis. Arlington, VA: National Osteoporosis Foundation; 2019.)***LIFESTYLE FACTORS**

Alcohol abuse	High salt intake	Low calcium intake
Excessive thinness	Immobilization	Smoking (active or passive)
Excess vitamin A	Inadequate physical activity	Vitamin D insufficiency
Frequent falling		

GENETIC DISEASES

Cystic fibrosis	Hypophosphatasia	Osteogenesis imperfecta
Ehlers-Danlos	Hypophosphatemia	Parental history of hip fracture
Gaucher's disease	Marfan syndrome	Porphyria
Hemochromatosis	Menkes steely hair syndrome	

HYPOGONADAL STATES

Anorexia nervosa	Hyperprolactinemia	Premature menopause (<40 yrs)
Androgen insensitivity	Hypogonadism	Turner's & Klinefelter's syndromes
Athletic amenorrhea	Panhypopituitarism	

ENDOCRINE DISORDERS

Central obesity	Diabetes mellitus (Types 1 & 2)	Thyrotoxicosis
Cushing's syndrome	Hyperparathyroidism	

GASTROINTESTINAL DISORDERS

Celiac disease	Gastrointestinal surgery	Pancreatic disease
Bariatric surgery	Inflammatory bowel disease	Primary biliary cirrhosis
Gastric bypass	Malabsorption syndromes	

HEMATOLOGIC DISORDERS

Hemophilia	Multiple myeloma	Systemic mastocytosis
Leukemia and lymphomas	Sickle cell disease	Thalassemia
Monoclonal gammopathies		

RHEUMATOLOGIC AND AUTOIMMUNE DISEASES

Ankylosing spondylitis	Other rheumatic and autoimmune diseases	Rheumatoid arthritis
		Systemic lupus

NEUROLOGICAL AND MUSCULOSKELETAL RISK FACTORS

Epilepsy	Multiple sclerosis	Spinal cord injury
Muscular dystrophy	Parkinson's disease	Stroke

MISCELLANEOUS CONDITIONS AND DISEASES

HIV/AIDS	Congestive heart failure	Idiopathic scoliosis
Amyloidosis	Depression	Post-transplant bone disease
Chronic metabolic acidosis	End stage renal disease	Sarcoidosis
Chronic obstructive lung disease	Hypercalciuria	Weight loss

MEDICATIONS

Aluminum-containing antacids	Depo-medroxyprogesterone (premenopausal contraception)	Parental nutrition
Androgen deprivation therapy	Glucocorticoids (≥ 5 mg/d prednisone or equivalent for ≥ 3 months)	Proton pump inhibitors Selective serotonin reuptake inhibitors
Anticoagulants (heparin)	GnRH (Gonadotropin releasing hormone) agonists	Tamoxifen [®] (premenopausal use)
Anticonvulsants	Lithium Cyclosporine A and tacrolimus	Thyroid replacement hormone (in excess)
Aromatase inhibitors	Methotrexate	Thiazolidinediones (such as Actos [®] and Avandia [®])
Barbiturates		
Cancer chemotherapeutic drugs		

ESTIMATING FRACTURE RISK USING THE FRAX[®] TOOL

Most fragility fractures occur in people who do not have osteoporosis by BMD criteria (DXA T-score ≤ -2.5). Factors other than bone density come into play. These clinical risk factors include race, age, previous fragility fracture, premature menopause, family history of hip fracture, and use of oral glucocorticoids. Data on these risk factors and their relative contributions to fracture have been validated through study of population-based cohorts from Europe, North America, Asia, and Australia. The models used in the Fracture Risk Assessment Tool, FRAX[®], algorithm are based on these data. Users must select appropriate regional and racial subcategory for an individual patient. The FRAX[®] tool projects probability of fracture on the basis of validated risk factors, with or without BMD measurement.

Table 2. Clinical Risk Factors in FRAX[®] and How to Enter Them

AGE	The FRAX [®] model accepts ages between 40 and 90 years. If ages below or above are entered, the program will compute probabilities at 40 and 90 years, respectively.
SEX	Male or female. Enter as appropriate
WEIGHT	This should be entered in kg. (conversion provided)
HEIGHT	This should be entered in cm. (conversion provided)
PREVIOUS FRACTURE	A previous fracture is defined as a fracture in adulthood that occurs spontaneously or from trauma that, in a healthy individual, would not have resulted in a fracture. A special situation pertains to a prior history of vertebral fracture. A vertebral fracture detected as a radiographic observation alone (a morphometric vertebral fracture) counts as a previous fracture. Both prior hip fracture and prior clinical vertebral fracture are especially strong risk factors. Probability of fracture may be underestimated in individuals who have experienced both hip and vertebral fractures or multiple fractures of either type.
PARENT FRACTURED HIP	History of hip fracture in the patient's biological mother or father.
CURRENT SMOKING[#]	This only applies to tobacco smoking and only to currently smoking. [#]

GLUCOCORTICOIDS[#]	Enter yes if the patient is currently exposed to oral glucocorticoids or has been exposed to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids) [#]
RHEUMATOID ARTHRITIS	Enter yes where the patient has a confirmed diagnosis of rheumatoid arthritis. Otherwise enter no. RA is a risk factor for fracture. However, osteoarthritis is, if anything, protective. For this reason reliance should not be placed on a patient's report of 'arthritis' unless there is clinical or laboratory evidence to support the diagnosis.
SECONDARY OSTEOPOROSIS	Enter yes if the patient has a disorder strongly associated with osteoporosis. These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition or malabsorption, and chronic liver disease.
ALCOHOL 3 OR MORE UNITS/DAY[#]	Enter yes if the patient drinks 3 or more units of alcohol daily. A unit of alcohol varies slightly in different countries from 8-10g of alcohol. This is equivalent to a standard glass of beer (285ml), a single measure of spirits (30ml), a medium-sized glass of wine (120ml), or 1 measure of an aperitif (60ml). [#]
BONE MINERAL DENSITY (BMD)	Select the make of DXA scanning equipment used and then either enter the patient's femoral neck BMD (in g/cm ²) or enter the patient's T-score. In patients without a BMD test, this field should be left blank. Only femoral neck BMD by DXA is accepted. T-scores are based on the NHANES reference values for women aged 20-29 years. The same absolute values are used in men.

[#]These risk factors appear to have a dose-dependent effect, i.e. the higher the exposure, the greater the risk. This is not taken into account and the computations assume average exposure. Clinical judgment should be used for low or high exposures.

Patient data are entered into the FRAX[®] calculator to generate ten-year projections for hip fracture and for major osteoporosis-related fracture (defined as fractures resulting from low-impact trauma, excluding fractures of face, fingers, and toes). These risk projections can be used with other clinical risk factors to inform treatment decisions in individual patients.

In the U.S. FDA-approved medical therapies should be considered in postmenopausal women and men aged 50 years and older, who meet one or more of the following criteria:*

1. Low bone mass (T-score between -1.0 and -2.5 at the femoral neck or spine) *plus* A and/or B below:
 - A. Three percent or higher FRAX-calculated 10-year probability of hip fracture *and/or*
 - B. Twenty percent or higher FRAX-calculated 10-year probability of major osteoporosis-related fracture (defined as fractures resulting from low-impact trauma, excluding fractures of face, fingers, and toes).
2. A hip fracture or vertebral fracture (clinical or morphometric) regardless of T-score.
3. T-score \leq -2.5 at the femoral neck or spine after appropriate evaluation to exclude secondary causes.

* Clinician judgment and/or patient preferences may indicate treatment for people with 10-year fracture probabilities above or below these levels.

FRAX® projections are based on data for treatment-naive postmenopausal women and men age 50 and older. FRAX® is not intended for use in younger adults, children, or patients who have taken medication for osteoporosis at any time in their lives. It may be used in previously treated individuals who have discontinued bisphosphonate therapy for 2 years and non-bisphosphonate therapy for 1 year.¹² This may change as data are continuously updated when new information is available from expanded reference populations.

The FRAX® program is available online at <http://www.shef.ac.uk/FRAX/>, as an iPhone app, a hand-held calculator, onboard many DXA machines, and in paper print-out form downloadable at www.shef.ac.uk/FRAX/

CLINICAL FALL-FRACTURE RISK ASSESSMENT

Among adults aged 65 or older, falls are the leading cause of both fatal and nonfatal injuries, including the majority of fractures and over 95% of hip fractures. According to CDC statistics, in 2011, an estimated 22,900 adults aged 65 and older were killed by unintentional fall injuries. There are many risk factors for falls. The most important of these are personal history of falling, muscle weakness and disordered gait, medications that cause sedation, and deficits in balance and vision.

Clinical assessment for fall risk should include:

- Physical exam and medication review
- Fall history
- Postural hypotension evaluation
- Gait, balance, and lower-extremity strength tests
- Vision check

Physical Exam & Medication Review. Many medical conditions and therapies impair balance and increase fall risk. These include conditions as disparate as depression, cardiac arrhythmia, and foot ulcers. Medications that make a person dizzy, sleepy, or uncoordinated also contribute to fall danger. Comorbid conditions are common in older adults, requiring multiple prescription and over-the-counter drugs. Many have sedating effects either alone or in combination, seriously compromising a patient's equilibrium and/or agility.

Many drugs increase the risk of falls, especially in older adults, include anticholinergics, psychoactive therapies (e.g. opioids, benzodiazepines, antidepressants, and

FALL RISK ASSESSMENT TESTS

THE 30-SECOND CHAIR STAND TEST

Tests leg strength and endurance. Fall risk indicator: Score below average for age and gender.

- Patient stands from seated position without using hands.
- Record how many times patient can stand and sit in 30 seconds.

THE TIMED UP AND GO (TUG) TEST

Assesses mobility. Fall risk indicator: Score ≥ 12 seconds signifies high risk.

- Patient stands, walks 3 meters, returns, and sits
- Record how many seconds it takes to complete.

THE 4-STAGE BALANCE TEST

Assesses static balance. Fall risk indicator: Inability to hold the tandem stance for 10 seconds.

- Patient stands unaided in 4 progressively more challenging positions.
- Record how long patient maintains position.

neuroleptics), antihistamines, and some nonsteroidal anti-inflammatory drugs (NSAIDs). In addition to drugs that cause fractures through falls, many medications are associated with elevated fracture risk due to direct effects on bone strength.

Fall History. Has the patient fallen since his/her last visit? What were the circumstances? Past falls are a significant predictor of future falls. Falls engender anxiety, which can itself increase risk of falling. Once a person has fallen, he or she may lose self-confidence and abandon activities that supported musculoskeletal and overall health. Confidence can be restored with exercise focused on strengthening muscles and improving balance.

Falls can be embarrassing. Without direct questioning, many patients are reluctant to report a fall to their healthcare provider. According to CDC statistics, while one out of three older adults falls each year, fewer than half talk to their healthcare providers about it. Having a friend or family member participate in a patient interview can sometimes elicit more complete information than seeing the patient alone.

Orthostatic Hypotension. Does the patient ever feel light headed after getting out of bed or after a large meal? Orthostatic, or postural, hypotension is common in older people as a result of medical conditions such as Parkinson's disease, hypertension, diabetes, and atherosclerosis or as a result of medications such as diuretics, antidepressants, or antihypertensives. It can also be caused by anemia, dehydration, or vitamin B12 deficiency.

To evaluate for postural hypotension:

1. Have the patient lie down for 5 minutes.
2. Measure blood pressure and pulse rate.
3. Have the patient stand.
4. Take blood pressure and pulse measurements right after patient stands up and again after patient has been standing for 3 minutes.

Systolic blood pressure that drops ≥ 20 mm Hg and/or diastolic blood pressure that drops ≥ 10 mm Hg are considered abnormal, as are vertigo or light-headedness. Interventions that prevent blood pooling in lower extremities can be helpful, such as pressure stockings and mattress wedges that elevate the head of the bed — as can decreasing the dose of medications contributing to hypotension or, when possible, discontinuing or substituting other medications. In some cases, medication to increase blood pressure and/or vascular tone may be beneficial.

Gait, Balance, and Lower Extremity Strength Assessment. Simple clinical tests have been validated to predict fall risk: the Timed Up and Go Test (TUG), the 30-Second Chair Stand Test, and the Four-Position Balance Test. These can be conducted by a medical assistant and documented in a patient's electronic medical record. Initial tests can be used to identify patients at risk and provide tangible evidence of their need for therapy and fall-prevention measures. Serial assessments can motivate compliance by indicating functional improvement or lack thereof.

Vision Assessment. Glaucoma, cataracts, macular degeneration, and other vision disorders prevalent in older adults can significantly impair ability to navigate safely through daily life. Color perception and contrast sensitivity decline with age-related yellowing of the lens. Blues and greens blur together, becoming harder to tell apart. A blue chair on a green rug could present a fall hazard for an elderly person who has a hard time seeing where the chair seat ends and the rug begins.

The situation is made worse by impaired depth perception, which is very common in the elderly and made worse by age-related cognitive decline and/or Alzheimer's disease. It may be difficult for an older person to see the edges of obstacles that don't have high-contrast borders to differentiate them from their surroundings. For example, stairs carpeted in a solid light color would be very hard to individuate, while steps with a dark riser and light tread could be easily distinguished.

In a bathroom, uniformly colored floor tile, wall tile, and fixtures present a greater hazard than tile and fixtures in contrasting colors. A white toilet against a white background is easily tripped over, especially late at night. Routine vision screening can be performed in a general practice clinic. However, a thorough eye exam by an ophthalmologist should be done annually.

The safety of a patient's home and work environment is critical to fall safety. It may be more difficult to assess as 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 nightlights, 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.⁶¹

A medical checklist is shown in the background, tilted at an angle. The items on the list include 'High Cholesterol', 'High Blood Pressure', 'Anxiety', 'Lower Back Pain', and 'Osteoporosis'. The 'Osteoporosis' checkbox is marked with a checkmark. A silver pen is positioned diagonally across the bottom right of the checklist. The entire scene is overlaid with a semi-transparent dark grey filter.

DIAGNOSING OSTEOPOROSIS

In the United States the standard criterion for diagnosing osteoporosis and applying the ICD-9 code 733.0 is a T-score of ≤ -2.5 at the lumbar spine, femoral neck, or total hip by bone mineral density (BMD) testing. As the T-score goes down, the risk for low-trauma fracture goes up. Data suggest that all fractures, regardless of precipitating trauma, should be recognized as potential evidence of bone fragility. Breaks suffered as the result of falling from a roof or having a motor vehicle accident are examples of medium-or high-trauma impacts and not in themselves diagnostic of osteoporosis.

WHO SHOULD BE TESTED?

The decision to perform bone density testing should be based on an individual's fracture risk profile and skeletal health assessment. Utilizing any procedure to measure bone density is not indicated unless results will influence treatment and management decisions. The U.S. Preventive Services Task Force recommends testing of all women age 65 and older and 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.¹³ Table 2 outlines indications for BMD testing.

Bone density measurement is not recommended in children or adolescents and is not routinely indicated in healthy young men or premenopausal women unless there is a significant fracture history or there are specific risk factors for bone loss.

Table 3. Indications for BMD Testing

CONSIDER BMD TESTING IN THE FOLLOWING INDIVIDUALS:

Women age 65 and older and men age 70 and older, regardless of clinical risk factors

Younger postmenopausal women, women in the menopausal transition, and men age 50 to 69 with clinical risk factors for fracture

Adults who have a fracture at age 50 and older

Adults with a condition (e.g., rheumatoid arthritis) or taking a medication (e.g., glucocorticoids) associated with low bone mass or bone loss

(Source: National Osteoporosis Foundation. *Clinician's Guide to Prevention and Treatment of Osteoporosis*. 2019)

BONE DENSITY MEASUREMENT BY DXA

Dual-x-ray absorptiometry (DXA) measurement of hip and spine is the preferred method for establishing and/or confirming a diagnosis of osteoporosis, predicting future fracture risk, and monitoring patients. Areal BMD imaging produced by DXA is expressed in absolute terms of grams of mineral per square centimeter scanned (g/cm²) and as a relationship to two BMD norms: an age-, sex- and ethnicity-matched reference population (Z-score), or a young-adult reference population of the same sex (T-score).

The difference between the patient's BMD and the mean BMD of the reference population, divided by the standard deviation (SD) of the reference population, is used to calculate Z-scores and T-scores. An individual's BMD is presented as the standard deviation above or below the mean BMD of the reference population, as outlined in Table 3. The BMD diagnosis of normal, low bone mass (osteopenia), osteoporosis, and severe or established osteoporosis is based on the WHO diagnostic classification.

Bone mineral density has been shown to correlate with bone strength and is an excellent predictor of future fracture risk. Fracture risk increases *exponentially* as BMD decreases. Although available technologies measuring central (lumbar spine and hip) and peripheral skeletal sites (forearm, heel, fingers) provide site-specific and global (overall risk at any skeletal site) assessment of future fracture risk, DXA measurement at the hip is the best predictor of future hip fracture risk.

Table 4. Defining Osteoporosis by BMD

WHO DEFINITION OF OSTEOPOROSIS BASED ON BMD

Normal	Within 1 SD of the mean level for a young-adult reference population	T-score at -1.0 and above
Low Bone Mass (Osteopenia)	Between 1.0 and 2.5 SD below that of the mean level for a young-adult reference population	T-score between -1.0 and -2.5
Osteoporosis	2.5 SD or more below that of the mean level for a young-adult reference population	T-score at or below -2.5
Severe or Established Osteoporosis	2.5 SD or more below that of the mean level for a young-adult reference population	T-score at or below -2.5 with one or more fractures

(Source: National Osteoporosis Foundation. *Clinician’s Guide to Prevention and Treatment of Osteoporosis*. 2019)

Dual-x-ray absorptiometry scans are associated with exposure to trivial amounts of radiation. Measurements of the lumbar spine and hip must be performed by trained technologists on well-calibrated and routinely tested instruments. For meaningful interpretation, serial scans should be performed on the same densitometry device at the same facility.

In premenopausal women, men less than 50 years of age, and children, the WHO BMD diagnostic classification should not be applied. In these groups, the diagnosis of osteoporosis cannot be made on the basis of densitometric criteria alone. The International Society for Clinical Densitometry (ISCD) recommends that ethnic- or race-adjusted Z-scores be used instead, with Z-scores of -2.0 or lower classified as “low bone mineral density for chronological age” or “below the expected range for age” and those above -2.0 “within the expected range for age.”

CLINICAL DIAGNOSTIC CRITERIA

In 2014, a working group of expert clinicians and clinical scientists convened by the National Bone Health Alliance (NBHA) published expanded criteria for the diagnosis of osteoporosis in postmenopausal women and men over age 50. The NBHA criteria enlarge risk stratification to include validated non-BMD risk factors for fracture. Based on these criteria and data from the NHANES database, 16% of men and 29.9% of women over age 50 have osteoporosis (as compared to the CDC estimate of 5.1% of men and 24.5% of women.)

NBHA expanded diagnostic criteria include:

- T-score at or below -2.5 at the spine or hip.
- Hip fracture regardless of bone density.
- Osteopenia (BMD T-score between -1 and -2.5) plus a vertebral, proximal humerus, pelvic, and in some cases distal forearm fracture.
- Fracture risk above treatment threshold on FRAX®.

BEYOND BMD: ASSESSING BONE QUALITY

Bone mineral density accounts for only about 70% of fracture risk. The -2.5 T-score diagnostic threshold is a modestly specific, but relatively insensitive, predictor of fracture risk. In one study of women 65 and older, more than half the women who experienced hip fractures did not have osteoporosis by BMD criteria.¹⁵

Prior vertebral compression fracture and BMD by DXA are among the strongest predictors bone strength. However, the majority of vertebral compression fractures are asymptomatic and therefore undetected. In addition, numerous factors that influence bone strength are not captured by DXA BMD measurement. These include skeletal geometry, micro-architectural deterioration, and mineralization properties of bone. Incorporating additional factors into an individual's risk profile significantly increases the clinical utility of bone mass measurement. Until recently it has not been clinically feasible to directly measure parameters of bone quality. Assessment of cortical porosity and trabecular microarchitecture was possible only by bone biopsy.

Currently, modalities used with DXA or in lieu of DXA are able to detect and/or quantify key features of bone predictive of strength and fracture resistance. Tools that provide information on fracture risk independent of include vertebral fracture assessment (VFA) and trabecular bone score (TBS) derived from DXA imaging, as well as less-often-utilized high-resolution refinements of computed tomography (CT), magnetic resonance imaging (MRI), and quantitative ultrasound (QUS).

Vertebral Fracture Assessment (VFA). Vertebral fracture assessment (VFA) improves diagnosis and reduces misclassification of osteoporosis compared with conventional DXA criteria.¹⁶ This is because vertebral compression fracture is strongly predictive of future fracture independent of BMD. The presence of a single vertebral fracture indicates the risk of subsequent vertebral fractures up to 5-fold higher and the risk of hip and other fractures 2- to 4- fold higher.^{17,18} The majority of vertebral compression fractures are asymptomatic. Without VFA, this vital clue to bone quality goes undetected.

Vertebral fracture assessment can be done on the latest generation of densitometry devices as well as using conventional lateral x-rays of the spine. Increasingly, VFA is done in conjunction with BMD assessment. DXA-based VFA has three significant advantages over standard radiography: lower radiation exposure, no need for a separate procedure, and in many cases, evaluation software that automatically identifies hard-to-detect vertebral abnormalities.

The finding of a previously unrecognized vertebral fracture may change the diagnostic classification, alter future fracture risk calculations, and affect treatment decisions. In people with vertebral compression fractures, anti-fracture treatment reduces future fracture incidence by as much as 75% (zoledronic acid).¹⁹

The NOF recommends consideration of vertebral imaging in the following individuals:

- All women age 70 and men age 80 and older if BMD T-score at the spine, total hip, or femoral neck is ≤ -1.0 .
- Women age 65 to 69 and men age 70 to 79 if BMD T-score at the spine, total hip, or femoral neck is ≤ -1.5

- Postmenopausal women and men age 50 and older with specific risk factors:
 - Low-trauma fracture during adulthood (age 50 and older)
 - Historical height loss of 1.5” or more (4 cm)
 - Prospective height loss of 0.8” or more (2 cm)
 - Recent or ongoing long-term glucocorticoid treatment
 - a. If bone density testing is not available, vertebral imaging may be considered based on age alone
 - b. Current height compared to peak height during young adulthood
 - c. Cumulative height loss measured during interval medical assessment

VFA interpretation is based on the shape and physical features of imaged vertebrae. This can pose a diagnostic challenge because, while all vertebral fractures cause deformity, all vertebral deformities are not caused by fracture. Further evaluation may be required to distinguish osteoporotic-related abnormalities from other benign and/or pathological processes, such as scoliosis or malignancy.

Trabecular Bone Score (TBS). Trabecular bone score (TBS) is a noninvasive analytical method for evaluating parameters related to bone strength and quality. Trabecular bone scores are derived from lumbar spine DXA images processed by dedicated software to create a three-dimensional projection of trabecular number, thickness, connectivity, and spacing.

TBS complements DXA’s BMD measurement with information on microarchitecture capturing independent fracture-risk parameters. This is of particular significance for individuals with BMD T-scores above -2.5, for whom fracture risk is elevated due to bone-destructive conditions not factored into FRAX, such as type 2 diabetes, primary hyperparathyroidism, rheumatoid arthritis, and glucocorticoid-induced osteoporosis.²⁰ In combination with the clinical risk factors, TBS enhances predictive power for risk of hip and non-hip major osteoporotic fractures as compared with TBS or FRAX alone.



FDA-APPROVED ANTIFRACTURE MEDICATIONS

Current FDA-approved pharmacologic options for prevention and/or treatment of postmenopausal osteoporosis include: bisphosphonates (alendronate, alendronate plus D, ibandronate, risedronate and zoledronic acid), calcitonin, estrogens (estrogen and/or hormone therapy), estrogen agonist/antagonist (raloxifene), parathyroid hormone (PTH[1-34], teriparatide), parathyroid hormone-related peptide [PTHrP(1-34)], abaloparatide), RANKL inhibitor (denosumab), sclerostin inhibitor (Romosozumab-aqqg) and tissue-selective estrogen complex (conjugated estrogens/bazedoxifene). Please see product-specific prescribing information for details of their use.

The antifracture benefits of FDA-approved drugs have mostly been studied in women with postmenopausal osteoporosis. There are limited fracture data on secondary causes of osteoporosis (e.g. diabetes, glucocorticoids) and osteoporosis in men. Medications FDA approved to prevent fractures in men with osteoporosis include the bisphosphonates alendronate, risedronate, and zoledronic acid, as well as the bone anabolic teriparatide, and the RANKL inhibitor denosumab. FDA-approved osteoporosis treatments have been shown to decrease fracture risk in male patients who have had fragility fractures and/or osteoporosis by DXA. Pharmacotherapy may also reduce fractures in men with low bone mass (osteopenia) without fractures, but the evidence supporting this isn't as strong.

Clinicians should assess potential benefits and risks of therapy in each patient in the context of a drug's fracture efficacy, onset of effect, duration limitations, magnitude of effect, and site of fracture prevention (e.g. spine vs hip).

The National Osteoporosis Foundation does not advocate the use of drugs not approved by the FDA for prevention and treatment of osteoporosis. *Note that intervention thresholds do not take into account the non-skeletal benefits or risks associated with specific drug use.*

Table 5. FDA-Approved Drugs for Osteoporosis

Drug	Brand Name	Form	Frequency	Gender
BISPHOSPHONATES				
Alendronate	Generic Alendronate and Fosamax®, Fosamax Plus D™	Oral (tablet)	Daily/Weekly	Women & Men
Alendronate	Binosto®	Effervescent tablet	Weekly	Women & Men
Ibandronate	Boniva®	Oral (tablet)	Monthly	Women
Ibandronate	Boniva®	Intravenous (IV) injection	Four Times a Year	Women
Risedronate	Actonel®	Oral (tablet)	Daily/Weekly/ Twice Monthly/ Monthly	Women & Men
Risedronate	Actonel® w/ Calcium	Oral (tablet)	Weekly	Women & Men
Risedronate	Atelvia™	Oral (tablet)	Weekly	Women & Men
Zoledronic Acid	Reclast®	Intravenous (IV) infusion	Once a Year/Once every two years	Women & Men
RANK LIGAND (RANKL) INHIBITOR				
Denosumab	Prolia™	Injection	Every 6 Months	Women & Men
CALCITONIN				
Calcitonin	Fortical®	Nasal Spray	Daily	Women
Calcitonin	Miacalcin®	Nasal Spray	Daily	Women
Calcitonin	Miacalcin®	Injection	Varies	Women
ESTROGEN* (HORMONE THERAPY)				
Estrogen	Multiple Brands	Oral (tablet)	Daily	Women
Estrogen	Multiple Brands	Transdermal (skin patch)	Twice Weekly/ Weekly	Women
ESTROGEN AGONISTS/ANTAGONISTS ALSO CALLED SELECTIVE ESTROGEN RECEPTOR MODULATORS (SERMS)				
Raloxifene	Evista®	Oral (tablet)	Daily	Women & Men
TISSUE-SELECTIVE ESTROGEN COMPLEX: CONJUGATED ESTROGENS/BAZEDOXIFENE				
Tissue-Selective Estrogen Complex	Duavee®	Oral (tablet)	Daily	Postmenopausal women (uterus intact)
SCLEROSTIN INHIBITOR (ANABOLIC AGENT)				
Romosozumab-aqqg	Evenity®	Injection	2 injections once monthly for 12 months	Women
PARATHYROID HORMONE (PTH) ANALOG				
Teriparatide	Forteo®	Injection	Daily	Women & Men
PARATHYROID HORMONE-RELATED PROTEIN (PTHrP) ANALOG				
Abaloparatide	Tymlos®	Injection	Daily	Women

BISPHOSPHONATES (ALENDRONATE, IBANDRONATE, RISEDRONATE, ZOLEDRONIC ACID)

Alendronate, brand name: Fosamax[®], Fosamax Plus D, Binosto[™] and generic alendronate.

Alendronate is approved by the FDA for the prevention (5 mg daily and 35 mg weekly tablets) and treatment of postmenopausal osteoporosis (10 mg daily tablet, 70 mg weekly tablet, 70 mg weekly tablet with 2800 units or 5600 units of vitamin D₃ and 70 mg effervescent tablet). Alendronate is also approved for treatment to increase bone mass in men with osteoporosis and for treatment of osteoporosis in men and women taking glucocorticoids.

Alendronate reduces incidence of spine and hip fractures by about 50% over three years in patients with a prior vertebral fracture and in patients who have hip BMD T-scores diagnostic of osteoporosis (≤ -2.5). It reduces incidence of vertebral fractures by 48% over three years in patients without a prior vertebral fracture.

Ibandronate, brand name: Boniva[®] and generic ibandronate. Ibandronate sodium is approved by the FDA for treatment of postmenopausal osteoporosis (150 mg monthly tablet and 3 mg every three months by intravenous injection). Oral ibandronate is also available as a generic preparation in the United States. The oral preparations are also approved for the prevention of postmenopausal osteoporosis. Ibandronate, 3 mg per 3 ml prefilled syringe, is given by intravenous injection, administered over 15 to 30 seconds, once every three months. Serum creatinine should be checked before each injection. Ibandronate reduces the incidence of vertebral fractures by about 50% over three years, but reduction in risk of nonvertebral fracture with ibandronate has not been documented.

Risedronate, brand name: Actonel[®], Atelvia[™] and generic risedronate. Risedronate sodium is approved by the FDA for the prevention and treatment of postmenopausal osteoporosis (5 mg daily tablet; 35 mg weekly tablet; 35 mg weekly delayed-release tablet; 35 mg weekly tablet packaged with 6 tablets of 500 mg calcium carbonate; 75 mg tablets taken on two consecutive days every month; and 150 mg tablet taken monthly). Risedronate is also approved for treatment to increase bone mass in men with osteoporosis and for prevention and treatment of osteoporosis in men and women who are either initiating or taking systemic glucocorticoids. Risedronate reduces incidence of vertebral fractures by 41% to 49% and non-vertebral fractures by 36% over three years, with significant risk reduction occurring within one year of treatment in patients with a prior vertebral fracture.

Zoledronic acid, brand name: Reclast[®]. Zoledronic acid is approved by the FDA for prevention and treatment of osteoporosis in postmenopausal women (5 mg IV infusion once yearly for treatment and once every two years for prevention). It is also approved to improve bone mass in men with osteoporosis and for prevention and treatment of osteoporosis in men and women expected to be on glucocorticoid therapy for at least 12 months. Zoledronic acid is also indicated for prevention of new clinical fractures in patients (both women and men) who have recently had a low-trauma hip fracture. Zoledronic acid reduces incidence of vertebral fractures, hip fractures, and non-vertebral in patients with osteoporosis (hazard ratio with zoledronate, 0.63; 95% confidence interval, 0.50 to 0.79; $P < 0.001$). The number of women that would need to be treated to prevent the occurrence of a

fracture in 1 woman was 15. As compared with the placebo group, women who received zoledronate had a lower risk of nonvertebral fragility fractures (hazard ratio, 0.66; P=0.001), symptomatic fractures (hazard ratio, 0.73; P=0.003), vertebral fractures (odds ratio, 0.45; P=0.002) and height loss (P<0.001).²¹

Bisphosphonate Administration and Side Effects. Oral bisphosphonates are poorly absorbed in the digestive tract. As a consequence, with the exception of delayed-release risedronate, all oral bisphosphonate medications must be taken on an empty stomach at least 30 minutes before first food or drink of the day and before taking any oral medication or supplement (including calcium, antacids, or vitamins) to maximize absorption and clinical benefit. Tablets must be swallowed whole with a full glass of plain water (6 to 8 ounces). Patients must avoid lying down for 30 minutes and refrain from eating or drinking anything except plain water or taking other medications for at least 30 minutes after taking the medication.

Delayed-release risedronate (Atelvia™) tablets must be taken immediately after breakfast with at least 4 ounces of plain water (no other liquid). After taking delayed-release risedronate, patients must wait at least 30 minutes before eating, drinking or taking any other medication. Patients should remain upright (sitting or standing) during this interval.

Side effects are similar for all oral bisphosphonate medications and include gastrointestinal problems such as difficulty swallowing, inflammation of the esophagus and stomach. Flu-like symptoms (arthralgia, headache, myalgia, fever) have been reported for IV zoledronic acid: 32% of patients after the first dose, 7% after the second dose and 3% after the third dose. To reduce the risk of an acute-phase reaction, patients should be well hydrated and pre-treated with acetaminophen (unless contraindicated).

All bisphosphonates can affect renal function and are contraindicated in patients with estimated GFR below 30-35 mL/min. Zoledronic acid is contraindicated in patients with creatinine clearance less than 35 mL/min, or in patients with evidence of acute renal impairment. Healthcare professionals should screen patients prior to administering zoledronic acid in order to identify at-risk patients and should assess renal function by monitoring creatinine clearance prior to each dose. Eye inflammation can also occur. Patients should be advised to report any such complication to their healthcare provider as soon as possible.

There have been rare reports of osteonecrosis of the jaw (ONJ) with long-term use of bisphosphonates for osteoporosis, though ONJ is much more commonly associated with high-dose intravenous bisphosphonate treatment for cancer. The risk of ONJ appears to increase with duration of treatment beyond five years.²²

Although rare, low-trauma atypical femur fractures may be associated with the long-term use of bisphosphonates (e.g. >5 years of use). Atypical femur fractures are often preceded by pain in the thigh and/or groin area, which can be bilateral. Clinicians should closely monitor for these unusual fractures, proactively questioning patients about occurrence of any thigh and/or groin pain. Patients who present with this prodrome may have experienced stress fracture in the subtrochanteric region

or femoral shaft. Bilateral femoral X-ray should be ordered, followed by an MRI or a radionuclide bone scan when clinical suspicion is high enough.²³ Surgical fixation is required in some cases, whereas medical conservative treatment is appropriate in other cases. If an atypical femur fracture is confirmed, bisphosphonates should be discontinued.

CALCITONIN

Brand name: Miacalcin® or Fortical® and generic calcitonin. Salmon calcitonin is FDA approved for the treatment of osteoporosis in women who are at least five years postmenopausal when alternative treatments are not suitable. Calcitonin is available in nasal spray and injectable form. Miacalcin nasal spray has not been shown to increase bone mineral density in early postmenopausal women. Calcitonin reduces vertebral fracture occurrence by about 30% in those with prior vertebral fractures but has not been shown to reduce the risk of nonvertebral fractures.^{54,24} Healthcare professionals should assess a patient's need for osteoporosis therapy, as well as the benefits and risks of available treatments. The FDA recommends that salmon calcitonin treatment should only be used in patients for whom alternative treatments are not suitable, and use should be re-evaluated on a periodic basis.

ESTROGEN/HORMONE THERAPY (ET/HT)

ET brand names: e.g. Climara®, Estrace®, Estraderm®, Estratab®, Ogen®, Premarin®, Vivelle®;
HT brand names: e.g. Activella®, Femhrt®, Premphase®, Prempro®. Estrogen/hormone therapy is approved by the FDA for the prevention of osteoporosis, relief of vasomotor symptoms and vulvovaginal atrophy associated with menopause. ET/HT is available in a wide variety of oral as well as transdermal preparations including estrogen only, progestin only and combination estrogen-progestin. ET/HT dosages include cyclic, sequential and continuous regimens. Women who have not had a hysterectomy require HT, which also contains progestin to protect the uterine lining. The Woman's Health Initiative (WHI) found that five years of HT (Prempro®) reduced the risk of clinical vertebral fractures and hip fractures by 34% and other osteoporotic fractures by 23 percent.

Due to possible increased risk for myocardial infarction, stroke, invasive breast cancer, pulmonary emboli and deep vein thrombosis, the FDA recommends that if being prescribed solely to prevent fractures, an approved non-estrogen treatment first be carefully considered.⁸⁶ When ET/HT treatments are stopped, bone loss can be rapid and alternative agents should be considered to maintain BMD.

ESTROGEN AGONIST/ANTAGONIST (SERM): RALOXIFENE

Brand name: Evista® and generic raloxifene. Raloxifene is approved by the FDA for both prevention and treatment of osteoporosis in postmenopausal women. Available as a 60 mg tablet. Raloxifene reduces risk of vertebral fractures by about 30% in patients with a prior vertebral fracture and by about 55% in patients without a prior vertebral fracture over three years. Reduction in risk of nonvertebral fracture with raloxifene has not been documented. Raloxifene is also indicated for reduction in risk of invasive breast cancer in postmenopausal women with osteoporosis. Raloxifene increases risk of deep vein thrombosis to a degree similar to that observed with estrogen. It can also cause hot flashes and leg cramps.

BONE-ANABOLIC AGENTS

There are three anabolic agents – abaloparatide, teriparatide and romosozumab-aqcg – currently FDA approved to treat osteoporosis in postmenopausal women and men at high risk for fracture due to multiple risk factors, including glucocorticoid therapy, and those whose risk remains high despite treatment with other antifracture medications. Both abaloparatide and teriparatide are associated with side effects that include leg cramps, nausea and dizziness. Because an increase in osteosarcoma was seen in animal studies (high doses, long duration treatment in rat), abaloparatide and teriparatide are contraindicated for patients with an increased risk of osteosarcoma, bone metastases, hypercalcemia, or a history of skeletal malignancy (e.g., patients with Paget’s disease of bone and/or history of radiation therapy). Due to a higher rate of major adverse cardiac events in a randomized controlled trial in postmenopausal women, romosozumab-aqcg should not be initiated in patients who have had a myocardial infarction or stroke within the preceding year. Consider whether the benefits outweigh the risks in patient with other cardiovascular risk factors. Romosozumab is also associated with side effects that include arthralgia, headache, hypersensitivity, hypocalcemia, osteonecrosis of the jaw and atypical femoral fracture. It is common practice to follow anabolic treatment with an antiresorptive agent, usually a bisphosphonate, to maintain or further increase BMD.

PTHrP(1-34) abaloparatide, brand name: Tymlos®. Administered by 80Qg daily subcutaneous injection in the periumbilical area of the abdomen, abaloparatide reduces the risk of vertebral fractures by about 57% and non-vertebral fragility fractures by about 43% in patients with osteoporosis, after an average of 18 months of therapy. Treatment duration is recommended not to exceed 24 months and must be followed by antiresorptive therapy to retain benefits.

PTH(1-34), teriparatide, brand name: Forteo®. Available as 20 Qg daily subcutaneous injection. Teriparatide reduces the risk of vertebral fractures by about 65% and non-vertebral fragility fractures by about 53% in patients with osteoporosis, after an average of 18 months of therapy. Treatment duration is recommended not to exceed 18 to 24 months. When treatment is discontinued, bone loss can be rapid and alternative agents should be considered to maintain BMD.

Sclerostin inhibitor, romosozumab-aqcg, brand name: Evenity®. A healthcare provider should administer the total dose of 210 mg by two separate subcutaneous injections. Syringes should be injected one after the other. This dose should be administered in the abdomen, thigh, or upper arm once every month for a total of 12 doses. Calcium and vitamin D should be adequately supplemented during treatment. In the first clinical trial, one year of treatment with romosozumab-aqcg reduced the risk of vertebral fracture by 73% compared to placebo. This benefit was maintained over the second year of the trial by treating with denosumab. In the second clinical trial, one year of treatment with Evenity followed by one year of alendronate reduced the risk of a new vertebral fracture by 50% compared to two years of alendronate alone.

RANK LIGAND INHIBITOR: DENOSUMAB

Brand name: Prolia®. Denosumab is approved by the FDA to treat osteoporosis in postmenopausal women and men at high risk for fracture due to multiple risk factors, which include prior fractures and treatment with bone-damaging drugs such as long-term systemic glucocorticoids, androgen deprivation, or aromatase inhibitors. Denosumab is administered by a health professional, every six months as a 60 mg subcutaneous injection.

Denosumab reduces the incidence of vertebral fractures by about 68%, hip fractures by about 40% and non-vertebral fractures by about 20% over three years. Denosumab may cause hypocalcemia; serious skin infections (cellulitis) and skin rash. Denosumab has also been associated with rare cases of osteonecrosis of the jaw (ONJ) and atypical femur fractures. When denosumab treatment is discontinued, bone loss can be rapid and may result in multiple vertebral fractures, especially in patients with a prior vertebral fracture.²⁶ Follow-on therapy with a bisphosphonate or other antiresorptive therapy is recommended.

TISSUE-SELECTIVE ESTROGEN COMPLEX: CONJUGATED ESTROGENS/ BAZEDOXIFENE

Brand name: Duavee®. Conjugated estrogens/ bazedoxifene (BZA/CE) is FDA-approved as an oral tablet for women who suffer from moderate-to-severe hot flashes (vasomotor symptoms) associated with menopause and to prevent osteoporosis after menopause. BZA/CE combines conjugated estrogen with an estrogen agonist/antagonist (bazedoxifene). The bazedoxifene component reduces the risk of endometrial hyperplasia (excessive growth of the lining of the uterus) that can occur with the estrogen component of the drug. Therefore progestins do not need to be taken with conjugated estrogens/bazedoxifene. In pivotal trials, BZA/CE significantly increased lumbar spine and hip BMD (1.5% and 1.2% respectively) at 12 months in a study comparing it to placebo in women one-to-five years post-menopause.^{27, 28}

Available as a tablet containing conjugated estrogens and bazedoxifene 0.45mg / 20mg, to be taken once daily without regard to meals. BZA/CE is intended only for postmenopausal women who still have a uterus. Side effects of BZA/CE include muscle spasms, nausea, diarrhea, dyspepsia, upper abdominal pain, oropharyngeal pain, dizziness and neck pain. Because BZA/CE contains estrogen, it is approved with the same Boxed Warning and other Warnings and Precautions that have been approved with estrogen products.





PATIENT-CENTERED MANAGEMENT OF OSTEOPOROSIS

All patients being considered for treatment of osteoporosis should also be counseled on risk reduction including adequate intake of calcium, vitamin D sufficiency, weight-bearing and muscle-strengthening exercise, smoking cessation, and avoidance of excessive alcohol intake. Patients may benefit from referral to specialists for nutritional counseling, physical therapy, smoking cessation support, and when needed, to alcohol or addiction treatment.

Prior to initiating pharmacologic antifracture treatment, patients should be evaluated for secondary causes of bone fragility and have BMD measurements by central DXA, when available, and vertebral imaging studies when appropriate. Pretreatment measurement of biochemical markers of bone turnover can also be a good idea since it provides a benchmark for comparison when monitoring treatment effect.

PRETREATMENT LABORATORY TESTS

Blood or Serum

- Alkaline phosphatase (ALP)
- Complete blood count (CBC)
- Chemistry levels (calcium, renal function, phosphorus and magnesium)
- Follicle-stimulating hormone (FSH) - women
- Liver function tests
- Parathyroid hormone (PTH) level
- Protein electrophoresis (multiple myeloma)
- Testosterone and gonadotropin levels - men
- Thyroid-stimulating hormone (TSH) level +/- free T4
- Vitamin D (25[OH]D level)

Urine

- 24-hour urinary calcium

Markers of Bone Turnover

- Biochemical markers of bone turnover

And, given that falls are the leading cause of fracture in older adults, it is critical that all patients being considered for treatment receive comprehensive fall risk evaluation and referral for at-home safety assessment and adaptive modifications.

NUTRITION TO OPTIMIZE ANTIFRACTURE THERAPY

In recent years, public health research has focused increasingly on the effect of dietary patterns on specific health outcomes, rather than on individual nutrients in isolation. Multiple studies have reported significant positive associations between bone health (BMD, fracture rates) and healthy dietary patterns that are high in fruit, vegetables, whole grains, poultry and fish, nuts and legumes, and low-fat dairy products.^{29,30} Comparing this to a Western, dietary pattern high in soft drinks, fried foods, processed foods, meat products, sugar, and refined grains, a large Swedish study found hip fracture rate was 31% lower in the highest compared to the lowest quartile of the healthy dietary pattern [HR (95% CI) 0.69 (0.64; 0.75)]. In contrast, women in the highest compared to the lowest quartile of the Western/convenience dietary pattern had a 50% higher [HR (95% CI) 1.50 (1.38; 1.62)] hip fracture rate.³¹

With this in mind, clinicians should encourage patients to focus on overall healthy nutrition, rather than on intake of individual vitamins and minerals. That said, there are two nutrients that are essential to bone acquisition in childhood and adolescence and prevention of osteoporosis in adulthood: calcium and vitamin D.

Calcium and vitamin D are also requisites for achieving optimal results from FDA-approved antifracture treatments. Fracture reductions reported from pivotal clinical trials occurred in patients with verified and consistent calcium and vitamin D intake. Establishing and maintaining adequate

levels of these essential nutrients is the first step in treating osteoporosis and preventing fractures. If pretreatment lab studies indicate calcium and/or vitamin D insufficiency, nutritional counseling and/or supplementation may be appropriate.

Improving calcium intake. A balanced diet rich in low-fat dairy products, fruits, and vegetables provides calcium as well as numerous nutrients needed for good health. When adequate calcium cannot be obtained from foods, supplementation is indicated up to the recommended daily intake.

Patients should be advised that calcium from foods is preferable to calcium from supplements. Foods contain beneficial co-nutrients. Food sources of calcium raise serum levels more gradually than supplemental sources (which may be safer for people at risk for kidney stones, for example). The NOF supports Institute of Medicine’s (IOM) calcium intake recommendation of 1000 mg per day for men age 50-70 and 1200 mg per day for women age 51 and older and men age 71 and older.³² There is no evidence that calcium intake in excess of these amounts confers additional bone benefit. Intake of *supplemental* calcium above 1200 to 1500 mg per day may increase risk for developing kidney stones.³³

The Calcium Calculator below is a simple method for estimating the calcium in a patient’s diet. Most people do not get enough. Average daily dietary calcium intake for 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.

CALCULATE YOUR CALCIUM

Are you getting enough calcium in your diet? Calcium needs vary at different times in your life. Here’s a general guide. Try keeping a diary of all the foods you eat for a week or two. Then use the results of a typical day to fill out this calcium calculator and compare your results to “Calcium and Vitamin D Recommendations” on page 30. If you find that you fall short, select a calcium supplement to make up the difference.

Product	Servings/day	Estimated calcium/ serving, in mg	Calcium in mg
Milk (8 oz.)	_____ x	300	= _____
Yogurt (8 oz.)	_____ x	415	= _____
Cheese (1 oz.)	_____ x	200	= _____
Fortified foods or juices	_____ x	80 to 1000*	= _____
Estimated total from other foods with smaller amounts of calcium			= <u>+250 mg</u>
TOTAL DAILY CALCIUM INTAKE			= _____

**Calcium content of fortified food varies. Check package label.*

(Source: National Osteoporosis Foundation. *Boning Up on Osteoporosis*. 2018)

Table 6. Calcium-Rich Foods (Patient Handout Included in this Toolkit)

PRODUCE	SERVING SIZE	ESTIMATED CALCIUM*
Collard greens, frozen	8 oz.	360 mg
Broccoli rabe	8 oz.	200 mg
Kale, frozen	8 oz.	180 mg
Soy Beans, green, boiled	8 oz.	175 mg
Bok Choy, cooked, boiled	8 oz.	160 mg
Figs, dried	2 figs	65 mg
Broccoli, fresh, cooked	8 oz.	60 mg
Oranges	1 whole	55 mg
SEAFOOD		
Sardines, canned with bones	3 oz.	325 mg
Salmon, canned with bones	3 oz.	180 mg
Shrimp, canned	3 oz.	125 mg
DAIRY		
Ricotta, part-skim	4 oz.	335 mg
Yogurt, plain, low-fat	6 oz.	310 mg
Milk, skim, low-fat, whole	8 oz.	300 mg
Yogurt with fruit, low-fat	6 oz.	260 mg
Mozzarella, part-skim	1 oz.	210 mg
Cheddar	1 oz.	205 mg
Yogurt, Greek	6 oz.	200 mg
American Cheese	1 oz.	195 mg
Feta Cheese	4 oz.	140 mg
Cottage Cheese, 2%	4 oz.	105 mg
Frozen yogurt, vanilla	8 oz.	105 mg
Ice Cream, vanilla	8 oz.	85 mg
Parmesan	1 tbs	55 mg
FORTIFIED FOOD		
Almond milk, rice milk or soy milk, fortified	8 oz.	300 mg
Orange juice and other fruit juices, fortified	8 oz.	300 mg
Tofu, prepared with calcium	4 oz.	205 mg
Waffle, frozen, fortified 2 pieces	2 pieces	200 mg
Oatmeal, fortified	1 packet	140 mg
English muffin, fortified	1 muffin	100 mg
Cereal, fortified	8 oz.	100-1,000 mg
OTHER		
Mac & cheese, frozen	1 package	325 mg
Pizza, cheese, frozen	1 serving	115 mg
Pudding, chocolate, prepared with 2% milk	4 oz.	160 mg
Beans, baked, canned	4 oz.	160 mg

*The calcium content listed for most foods is estimated and can vary due to multiple factors. Check the food label to determine how much calcium is in a particular product.

Table 7. Recommended Calcium and Vitamin D Intakes for Women and Men

LIFE STAGE GROUP	CALCIUM Recommended Dietary Allowance (mg/day)	CALCIUM Safe Upper Limit (mg/day)	VITAMIN D IOM/(ES)NOF Recommendation (units/day)	VITAMIN D Safe Upper Limit (units/day)
51-70 year old women	1,200	2500	600/800-1000	4000
51-70 year old men	1,000	2000	600/800-1000	4000
70+ years old men and women	1,200	2000	600/800-1000	4000

Improving serum vitamin D. Vitamin D facilitates calcium absorption and is thought to play a role in prevention of falls. The NOF recommends a daily intake of 800 to 1000 units of vitamin D for adults age 50 years and older. Reference IOM intakes are 600 units daily until age 70 years and 800 units thereafter. These IOM intakes are sufficient to maintain a serum 25(OH)D of 20 ng/mL in ≥97.5% of population. However, a higher serum 25(OH)D level (>30 to 32 ng/mL) is associated with optimal calcium absorption and so is preferred by the NOF, the Endocrine Society, and others.^{34, 35, 36} (See *Table 11.*)

Skin production of vitamin D declines with age, which contributes to the high prevalence of vitamin D deficiency in older adults, especially those who have limited exposure to sunlight (i.e. nursing home residents) and or chronic conditions that hamper vitamin D metabolism (e.g. kidney disease, malabsorption syndromes, obesity). Vitamin D deficiency is common in patients with osteoporosis, even patients taking osteoporosis medications.^{37, 38}

Serum 25(OH)D levels should be measured in patients at risk of vitamin D deficiency. Vitamin D is found in very few foods. Sources include mushrooms (especially when exposed to sunlight) and fatty fish like wild-caught mackerel, salmon, and tuna. Vitamin D is added to milk and other dairy products, orange juice, soymilk, and fortified cereals.

Adults who are vitamin D deficient are typically treated with 50,000 supplemental units of vitamin D2 or vitamin D3 once a week or the equivalent daily dose (7000 units vitamin D2 or vitamin D3) for 8-12 weeks to achieve a 25(OH)D blood level of approximately 30 ng/ml. This regimen should be followed by maintenance therapy of 1000–2000 units/day or whatever dose is needed to maintain the target serum level.^{39,40} Adults with ongoing malabsorption may require high replacement doses of vitamin D to reach and sustain sufficiency.

WHO SHOULD BE CONSIDERED FOR PHARMACOLOGIC TREATMENT?

Postmenopausal women and men age 50 and older presenting with the following should be considered for treatment: hip or vertebral fracture, wrist fracture plus low BMD, T-score <-2.5, and/or low BMD and high FRAX® score.

FOOD	SERVING SIZE	VITAMIN D CONTENT
Canned salmon (with bone)	1 can (369 grams)	2816 IU
Salmon, fresh roasted	1/2 filet	815 IU
Canned tuna (in oil, drained)	3 ounces	229 IU
Whole milk (cow)	1 cup	124 IU
Soy milk (Silk brand plain)	1 cup	119 IU
Low fat milk (1%)	1 cup	117 IU
Orange juice (fortified)	1 cup	89 IU
Kellogg's All-Bran Cereal (original)	1/2 cup	51 IU
Egg, whole, hard boiled	1 large	44 IU
Spinach souffle	1 cup	42 IU
Mushrooms (fresh, shitake)	1 cup	41 IU
Cheddar Cheese	1 ounce	7 IU

Hip or vertebral fracture. The occurrence of a fragility fracture is highly predictive of future fractures. Risk triples after the first vertebral fracture and increases up to 23 times after the third. Fracture incidence declines in patients with spine or hip fractures who are treated with approved pharmacologic agents. This is true for patients with previous fractures, whether their T-score classification is osteopenia (low bone mass) or osteoporosis.

Wrist or forearm fracture plus low BMD. Treatment should be considered for any postmenopausal woman or a man aged ≥ 50 years with low BMD who fractures a wrist or forearm. In this scenario, T-score is less predictive of future fracture risk than the fracture itself.

T-score ≤ -2.5 plus low BMD. Decades of high-quality evidence demonstrate that pharmacotherapy prevents fracture in patients with osteoporosis by BMD-DXA at any clinically relevant site (femoral neck, total hip, or lumbar spine).

Low bone mass and FRAX[®] score above treatment threshold. A BMD T-score between -1.0 and -2.5 at the femoral neck or lumbar spine and a 10-year probability of a hip fracture $\geq 3\%$ or a 10-year probability of a major osteoporosis-related fracture $\geq 20\%$ based on the US-adapted FRAX[®] algorithm are indicative of high fracture risk and need for pharmacologic intervention.

CHOOSING AN ANTIFRACTURE MEDICATION

The ideal medication for initiating therapy is the one most likely to achieve an acceptable reduction of fracture risk in an acceptable period of time. This requires stratification of patients according to estimated risk for fracture before treatment and the pharmacodynamics of a particular therapeutic agent.

As data on antifracture treatment strategies emerge, it becomes increasingly possible to “treat to target” in patients with osteoporosis. The targeted treatment success can be measured by absence of fractures, by stable BMD, or by increasing BMD above the least significant change for the applicable screening device. For example, in a patient who has already experienced a vertebral fracture, a

reasonable goal could be remaining fracture free for five years. In a patient with low bone density and risk factors who has not experienced a fracture, the goal might be preventing a first fracture or increasing BMD T-score to above the threshold for osteoporosis (-2.5).

When setting treatment goals, variables to consider include the patient's degree of bone loss, history and recency of fracture, and history of antifracture therapy (type, duration, response). Based on these factors, the clinician can identify medication(s) most likely to achieve the treatment target given the medication's specific characteristics: speed of effect onset, magnitude of effect, site of effect (e.g. hip or spine), durability of effect following discontinuation, cost and availability, and other considerations.

CONSIDERING SEQUENTIAL AND COMBINATION THERAPY

Patients with recent fractures and/or very low BMD (e.g., T-score < -3.0) are at especially high risk for future fracture. Monotherapy with antiresorptives may not be sufficient to lower risk to acceptable levels in these patients. Consideration of more aggressive therapy with combination or sequential use of antifracture medications may be warranted.

Combination and/or sequential use of anabolic and potent antiresorptives have been demonstrated to produce and sustain BMD increases better than monotherapy with any one agent. Combination therapy in which an anabolic agent and antiresorptive therapy are co-administered may be appropriate in a setting of severe osteoporosis that includes fractures of hip and spine.⁴¹ There are few indications for combining two antiresorptive treatments.

Research suggests that BMD and fracture outcomes are significantly influenced by the order in which antifracture agents are administered. An anabolic agent administered following antiresorptive therapy has demonstrably less impact on BMD and fracture risk than if the anabolic is administered first.⁴² When anabolic therapy is administered after a potent antiresorptive agent a delay or attenuation of effect or even resumption of bone loss may be seen. When sequential treatment is considered, anabolic therapy followed by an antiresorptive agent is preferred.

Multiple factors contribute to outcomes: drugs used, duration of treatment, and patient characteristics, for example. More research is needed to determine the best order and most appropriate drugs for combination and sequential therapy in individual patients.

DISCUSSING RISKS AND BENEFITS OF TREATMENT OPTIONS

Osteoporosis is a chronic condition that requires long-term multimodal management. A wide variety of highly effective treatment options are available. Women with osteoporosis cut in half their risk of risk of hip, spine, and wrist fractures by taking antifracture medication. However, these drugs only work if they are taken as prescribed. Unfortunately, osteoporosis medications have notoriously low patient compliance – it is estimated that 25% of patients don't even fill their prescriptions and of those who do, fewer than half take them as prescribed or continue taking them after one year.

Patients may unintentionally fail to initiate treatment due to forgetfulness, overly complex treatment

regimens, and/or drug unaffordability. When surveyed, patients who intentionally didn't follow prescribed osteoporosis pharmacotherapy cite fear of side effects, distrust in medication in general, and a lack of belief in the need for medication or in its effectiveness. Patients often do not understand their risk for fractures. Even those who do, may not appreciate the disability and loss of independence that often follow fragility fracture. This is a particular problem with silent diseases like osteoporosis in which symptoms do not get observably better or worse in response to pharmacotherapy.

It can be difficult to counteract media messages that exaggerate the risk of rare adverse events such as osteonecrosis of the jaw and atypical femur fracture, which have been associated with long-term use of bisphosphonate drugs in certain patients. Graphic representations that visually contrast risk of fracture with risk of a particular adverse event can be a great help.

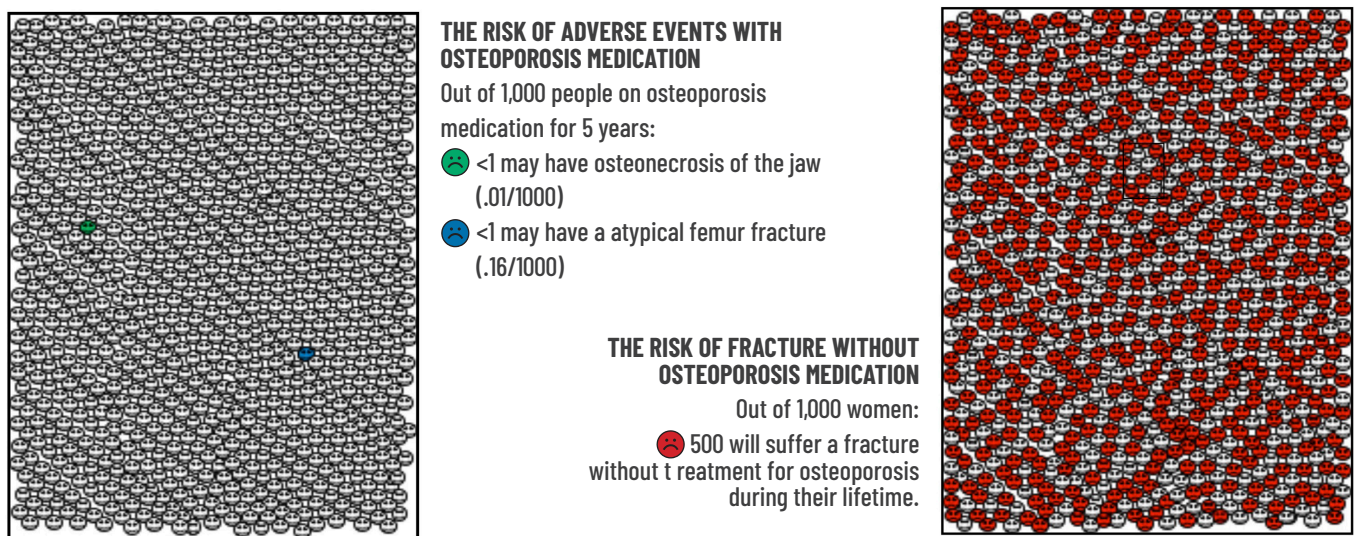


Figure 3. For most people, it is easier to understand relative risks when they are represented graphically, as they are in this representation comparing data on incidence of rare adverse events and incidence of (common) osteoporosis-related fracture.

PLANNING AHEAD: TREATMENT DURATIONS, HOLIDAYS, AND FOLLOW-ON THERAPIES

No pharmacologic regimen should be considered permanent. Discontinuation or modification should be anticipated and planned for. Treatment plans must accommodate specific drug effects and limitations. All non-bisphosphonate medications produce temporary effects that wane upon discontinuation. If these treatments are discontinued, benefits rapidly disappear. In contrast, bisphosphonates produce residual effects after treatment discontinuation. Therefore, it may be possible to discontinue bisphosphonates and retain benefits against fracture at least for several years.

Data suggest that incidence of rare safety concerns such as ONJ and atypical femur fractures increases with higher doses and longer treatment periods.⁴³ Besides this, we do not yet have a great deal of data on the comparative benefits and harms related to specific durations of treatment with specific drugs. Decisions about how long to treat with a particular drug must be tailored to individual patients.

After an initial three-to-five year treatment period, a comprehensive risk assessment should be performed that includes interval clinical history, particularly with respect to intercurrent fractures and any new diseases or medications. Height measurement is critical as it is often the only evidence of vertebral compression fracture. If significant height loss is documented during the treatment period, BMD testing and vertebral imaging should be done. Height loss is considered significant if it is 1.5" or more since peak height at age 20 or a loss 0.8" or more in one year.

Considering a bisphosphonate drug holiday. Drug holidays are not appropriate for non-bisphosphonate classes of drugs. For patients treated with bisphosphonates, temporary discontinuation (a bisphosphate "holiday") can be considered after three to five years for individuals who appear to be at modest risk of fracture (e.g, T-score > -2.5 and no recent fracture). In contrast, for those who continue to demonstrate high fracture risk (e.g., T-score \leq -2.5 and/or recent fracture), continued treatment with a bisphosphonate should be considered DD -- up to 10 years with an oral bisphosphonate and up to 6 years with annual IV zoledronic acid.

The rationale for a bisphosphonate holiday is the expectation that antifracture benefit for appropriately selected patients will continue for an undefined period of time, perhaps several years, while the risk of rare possible adverse effects, such as atypical femur fracture, may quickly decline.

Post-holiday follow-up and follow-on therapy. For patients treated with a non-bisphosphonate, treatment effect rapidly dissipates when treatment is stopped. This is a particular concern with discontinuation of denosumab, which has been associated with a rise in bone turnover markers, decline in BMD, and increased risk of multiple vertebral fractures, especially in patients with a prior vertebral fracture. After discontinuing treatment with denosumab, high-risk patients should be switched to another antiresorptive, possibly a bisphosphonate. Prompt initiation of antiresorptive follow-on therapy has been found to better preserve bone density gains made during denosumab treatment.

Since osteoporosis is a lifelong disease, pharmacotherapy should be periodically reevaluated to determine whether treatment should be continued, changed, stopped, or resumed. The decision-making process should involve a patient-focused discussion about risks and benefits as well as treatment options.

MONITORING TREATMENT RESPONSE

Annually, review bone health status and discuss future management strategies. Some treatment naïve patients may need to initiate antifracture treatment while others may be able to suspend treatment for a period of time after several years of therapy, particularly if they are taking bisphosphonates. Patients who remain at high risk for fractures will need continued treatment.

When a treatment is suspended, patients should be monitored for resumption of bone loss through clinical assessment for new fractures, falls, and/or medical conditions. Clinical assessment includes serial measurement of bone density and biochemical markers of bone turnover and vertebral imaging

Table 5. Factors to consider when making treatment decisions for patients on bisphosphonate therapy

PATIENT'S RISK FOR FRACTURE	SUGGESTED DURATION OF TREATMENT	SUGGESTED DURATION OF BIPHOSPHONATE HOLIDAY
Low Risk (e.g., prevention)	Don't treat	N/A
Mild Risk (e.g., <65 T-score just below -2.5 + no additional risk factors or osteopenia with risk factors)	Treat for 4-5 years (alendronate/risedronate) or 3 years (zoledronic acid) *	If BMD is stable, stop until significant Δ in BMD, increase in bone markers, or occurrence of fracture
Mild Risk (e.g., <65 T-score just below -2.5 + no additional risk factors or osteopenia with risk factors)	Treat 5-10 years (alendronate/risedronate) or 3 years (zoledronic acid)	If BMD is stable, stop for 2-3 years (alendronate/zoledronic acid) or 1 year (risedronate) or until significant decrease in BMD, increase on bone markers, or fracture
High Risk (e.g., >65 very low BMD, multiple risks or fractures)	Treat 10 years *Many experts recommend avoiding bisphosphonates in younger women with osteopenia.	If BMD is stable, stop for 1-2 years or until significant Δ in BMD increase on bone markers, or fracture; possibly use alternate medication during holiday, such as raloxifene or teriparatide.

in patients exhibiting signs of vertebral fracture, such as height loss or back pain.

It is important to have accurate baseline values against which to compare serial test results.

Serial DXA. Central DXA assessment of the hip or lumbar spine is the “gold standard” for serial assessment of BMD. Biological changes in bone density are small compared to the inherent error in the test itself, and interpretation of serial bone density studies depends on appreciation of the smallest change in BMD that is beyond the range of error of the test. This least significant change (LSC) varies with the specific instrument used, patient population being assessed, measurement site, technologist’s skill with patient positioning and test analysis, and the confidence intervals used. Changes in the BMD of less than 3-6% at the hip and 2-4% at the spine from test to test may be due to the precision error of the testing itself. Information on how to assess precision and calculate the LSC is available at www.ISCD.org.

For comparable values, measurement should be done in the same facility and on the same densitometry device. The National Osteoporosis Foundation recommends following Medicare guidelines to repeat BMD assessments every two years, with the understanding that testing more frequently may be warranted in individual patients.

Biochemical markers. Changes in biochemical markers of bone turnover have been correlated with fracture risk reduction in large clinical trials. Like, DXA scores, variations in biomarkers must exceed the LSC in order to be clinically meaningful. The LSC is specific to the biomarker being utilized. Biological variability can be constrained by obtaining samples in the early morning after an overnight fast. Serial measurements should be made at the same time of day at the same laboratory.

Table 6. Clinical Approach to Managing Osteoporosis

GENERAL PRINCIPLES

- Obtain a detailed patient history pertaining to clinical risk factors for osteoporosis-related fractures and falls
- Perform physical examination and obtain diagnostic studies to evaluate for signs of osteoporosis and its secondary causes
- Modify diet/supplements, lifestyle and other modifiable clinical risk factors for fracture
- Estimate patient's 10-year probability of hip and any major osteoporosis-related fracture using the U.S.-adapted and perform vertebral imaging when appropriate to complete risk assessment
- Decisions on whom to treat and how to treat should be based on clinical judgment using this Guide and all available clinical information

CONSIDER FDA-APPROVED MEDICAL THERAPIES BASED ON THE FOLLOWING

- Vertebral fracture (clinical or asymptomatic) or hip fracture
- Hip DXA (femoral neck or total hip) or lumbar spine T-score ≤ -2.5
- Low bone mass (osteopenia) and a U.S.-adapted WHO 10-year probability of a hip fracture $\geq 3\%$ or 10-year probability of any major osteoporosis-related fracture $\geq 20\%$
- Patient preferences may indicate treatment for people with 10-year fracture probabilities above or below these levels

CONSIDER NON-MEDICAL THERAPEUTIC INTERVENTIONS

- Modify risk factors related to falling
- Consider referrals for physical and/or occupational therapy evaluation (e.g., walking aids and other assistive devices)
- Weight-bearing, muscle-strengthening exercise and balance training

FOLLOW-UP

- Patients not requiring medical therapies at the time of initial evaluation should be clinically re-evaluated when medically appropriate
- Patients taking FDA-approved medications should have laboratory and bone density re-evaluation after two years or more frequently when medically appropriate
- Vertebral imaging should be repeated if there is documented height loss, new back pain, postural change or suspicious finding on chest x-ray, following the last (or first) vertebral imaging test or in patients being considered for a temporary cessation of drug therapy to make sure no new vertebral fractures have occurred in the interval
- Regularly, and at least annually, assess compliance and persistence with the therapeutic regimen

Vertebral fracture assessment (VFA). Vertebral fractures can be imaged using standard lateral spine x-ray or DXA-based vertebral fracture assessment. Once the first vertebral imaging test has been performed to determine prevalent vertebral fractures (indications above), repeat testing should be performed to identify incident vertebral fractures if there is a change in the patient's status suggestive of new vertebral fracture, including documented height loss, undiagnosed back pain, postural change, or a possible finding of new vertebral deformity on chest x-ray. If patients are being considered for a temporary cessation of drug therapy, vertebral imaging should be repeated to confirm that no vertebral fractures have occurred in the interval off treatment. A new vertebral fracture on therapy indicates need for more intensive or continued treatment rather than treatment cessation.





IMPROVING OUTCOMES FOLLOWING FRACTURE

The most common fragility fractures are those of the proximal femur (hip), vertebrae (spine), and distal forearm (wrist). All can cause pain, impairment, and loss of independence. Prompt prophylactic pain control and therapeutic mobilization are essential to long-term improvements in function and quality of life. Table 8 lists pain control modalities that apply to fragility fractures.

PAIN MANAGEMENT FOR ACUTE FRACTURES

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 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 keep fall risk in mind. 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.

REHABILITATION FOLLOWING HIP FRACTURE

In terms of mortality and disability, hip fractures are the most serious osteoporotic fracture. An estimated 24% of hip fracture patients over age 50 die in the year following fracture.^{44, 45} 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.⁴⁶ At 6 months after a fracture, just 15% of hip fracture patients can walk across a room unaided.⁴⁷ Consequently, 25% of those who were ambulatory before a hip fracture require long-term care afterwards.⁴⁸

Exercise for hip fracture rehabilitation. 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 returns. 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 pads can reduce fracture risk in individuals at high risk for falls. Physiatrists, medical doctors with specialization in physical medicine and rehabilitation, can customize adaptive devices and therapies to meet the needs of individual patients.

REHABILITATION FOLLOWING FOREARM FRACTURE

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. Optimal treatment depends 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. During the cast or bracing stage, arm elevation, early mobilization, and edema-control measures are critical to functional recovery. Rehabilitation should begin while the hand is still immobilized in a cast. Early therapy improves digit motion and yields better patient outcomes and patient satisfaction.⁴⁹ Unfortunately the vast majority of patients are not referred to therapy during this critical period of immobilization.

Exercise for wrist fracture rehabilitation. 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 should be started while the arm is casted or 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.

REHABILITATION FOLLOWING VERTEBRAL FRACTURE

Vertebral compression fracture occurs when individual vertebrae become so weak that they collapse. Two-thirds of vertebral fractures are asymptomatic “silent” fractures. Most do not usually require hospitalization. However, multiple thoracic and lumbar fractures can cause spinal deformity, leading to restrictive lung disease, constipation, pain, distention, and reduced appetite. Vertebral fractures also convey a significant increase in hospitalization and mortality risk.

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 U.S. 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 are valuable to avoid stiffness and bone/muscle loss. Long-term immobilization or prolonged inactivity is detrimental to bone and to the patient’s general health and should be avoided. A variety 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.

Exercise for vertebral fracture rehabilitation. 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 damaging loads on the spine.

SURGICAL INTERVENTIONS FOR ACUTE VERTEBRAL FRACTURE PAIN

Nonsurgical pain management works for most patients recovering from uncomplicated vertebral compression fracture. However, some patients experience intractable pain and some cannot tolerate conservative therapies. For these patients surgical intervention may be beneficial. A primary source

of the intense pain some people experience following a vertebral fracture is the movement of bone fragments against one another. Pain can be dramatically reduced when these fragments are immobilized surgically using vertebral augmentation.

The two most widely performed vertebral augmentation procedures are percutaneous vertebroplasty and percutaneous balloon kyphoplasty. In both, specially formulated bone cement is injected into the central chamber of a crushed vertebral body through either one or two posterior cannulas positioned under fluoroscopic guidance (less often, CT). Both procedures require only a small incision through which the cannula is placed using a very thin biopsy needle. Standard bone cement hardens in about 10 minutes, trapping loose bone fragments, stabilizing the vertebrae, and significantly reducing acute/subacute and chronic pain for the short and long term. In kyphoplasty, balloon expansion in the vertebral cavity can restore height lost to vertebral collapse improving spinal alignment. Vertebral augmentation is most effective while a fracture is healing. In older, healed fractures, vertebral augmentation usually cannot increase vertebral height.

Complications associated with vertebral augmentation. The most frequently observed complication seen with vertebral augmentation is fracture in adjacent vertebral segments typically occur shortly after surgery. Other complications include cement leakage (usually asymptomatic, but potentially serious), spinal compression with radiculopathy, cement embolism, and infections.

MANAGING CHRONIC BONE AND MUSCLE PAIN

Once a fragility fracture is repaired, the goal of patient care shifts to managing chronic pain, preventing future fractures, and improving quality of life. Pharmacological treatment of pain in patients with osteoporosis is usually insufficient. A combination of medications, nutritional counseling, physical/occupational 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.

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 from multiple fractures.

Multiple compression fractures can eventually 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.

HELPING PATIENTS COPE WITH OSTEOPOROSIS: PSYCHOSOCIAL SUPPORTS

Depression and fear of falling are common psychological consequences of osteoporosis. Both often lead to isolation, inactivity, and fractures. Fortunately, these conditions can be successfully diagnosed and treated.

Psychotherapy can be effective in many patients who have developed anxiety or depression due to their diagnosis. However, when symptoms do not resolve or are 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/antianxiety 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 enable patients with chronic diseases to successfully manage their disease. As a result, such patients feel more in control and report overall improvement in symptoms.

When designing task-specific interventions tailored to individual patient needs, it is important to assess fear of falling related to specific functional activities, such as walking on icy surfaces, rising from chairs, or climbing stairs after dark. With this information, the clinician can recommend appropriate physical therapy, exercise, or adaptive modifications.

Table 8. Pain management approaches for osteoporosis and related fractures

ACUPUNCTURE, ACUPRESSURE, AND MASSAGE THERAPY	Acupuncture and acupressure have been demonstrated to control pain in patients with osteoporosis. Many health insurance providers now offer coverage or discounts for acupuncture and acupressure. Gentle massage can relieve muscle spasms. Deep tissue massage therapy should be avoided in people who have experienced fragility fractures.
ANTIDEPRESSANTS	Can improve chronic nerve pain from severe VCF (except fluoxetine). SSRIs potentially increase bone loss and fractures.
ANTI-INFLAMMATORIES	Beneficial for suppressing inflammation-related pain; however, may delay bone healing following fracture, except for anti-COX-2 NSAIDs.
ANTI-OSTEOPOROTICS: BISPSPHONATES	Decreases acute and/or chronic pain and stiffness and improves function and quality of life (possibly due to suppression of pain-related neuropeptides and inflammatory cytokines).
ANTI-OSTEOPOROTICS: CALCITONIN	Mitigates chronic fracture pain in patients with osteoporosis. Limiting use duration is recommended due to cancer and hypocalcemia warnings. Applicable to acute or chronic pain.

ANTI-OSTEOPOROTICS: DENOSUMAB	Demonstrated reduction in acute pain from osteoporosis-related fractures (with 12 months of treatment). Little evidence for long-term chronic pain.
ANTI-OSTEOPOROTICS: RALOXIFENE	Correlated with reduction in acute and/or chronic skeletal pain and improved sleep quality in women with osteoporotic fractures.
ANTI-OSTEOPOROTICS: TERIPARATIDE	Research shows faster healing and reduced pain of new fractures. Prevents bone loss and osteoporosis. Applicable to acute or chronic pain.
ANTISPASMODICS	Controls chronic muscle spasms from spinal curvature. Complications: increases fall risk, constipation, and indigestion.
BIOFEEDBACK	Biofeedback therapy can be helpful for managing acute and/or chronic pain due to fractures. Referral should be made to biofeedback specialist.
FACET JOINT INJECTION	Effective for acute and/or chronic pain from unstable fracture in spinal facet joints.
ICE AND HEAT	Application of ice and/or heat, alternating or individually, can promote healing and be effective in reducing swelling, improving blood flow, and relieving pain of muscle spasms. Specific injury dictates appropriate method, purpose, and application (e.g, heat may not be appropriate for acute fracture with
NERVE BLOCK	Can provide temporary relief for new VCF of lumbar spine (< 4 weeks).
NSAIDS	Over-the-counter anti-inflammatory pain relievers taken every six hours following fracture can help suppress inflammatory processes that exacerbate pain of osteoporosis fractures. Standard precautions apply.
OPIOIDS	Very effective, but lose potency, raise risk for addiction, constipation, falls, and central sensitization. Recommended for short-term use with acute fractures.
PULSED ELECTRO- MAGNETIC FIELDS (PEMPFS)	Low-frequency pulsed electro-magnetic fields have been demonstrated to relieve pain of acute fractures. Referral to physiatry or physical therapy needed.
RELAXATION TECHNIQUES	Deep breathing, progressive muscle relaxation, guided imagery, and other relaxation techniques can help release muscle tension and mitigate pain, both acute and chronic.
TOPICAL PAIN RELIEVERS	Weak, short-lived acute and/or chronic pain-control effect.
TRANSCUTANEOUS ELECTRIC NERVE STIMULATION (TENS)	TENS reduces chronic pain and relieves muscle spasm through transmission of mild electrical current. Referral to physiatry or physical therapy needed.
VERTEBRAL AUGMENTATION	Minimally invasive surgical vertebral augmentation, through vertebroplasty or kyphoplasty, can relieve severe pain from vertebral fractures. In unhealed, acute fractures, kyphoplasty can also restore vertebral height lost to compression fracture. Warnings regarding cement leakage, adjacent fractures, and other complications.
VIBRATION THERAPY	The analgesic effects of whole-body vibration have been reported in studies of patients with osteoporosis and fractures.
VITAMIN D	Vitamin D deficiency is associated with chronic pain. Although vitamin D on its own has not been shown to relieve pain from fractures, it is critically important to bone health. Clinicians should monitor serum levels and ensure sufficiency in all patients, and especially those with osteoporosis and bone pain.



EXERCISE FOR OSTEOPOROSIS: REAPING BENEFITS & AVOIDING HARMS

As part of multi-factorial treatment that includes pharmacotherapy, nutritional support, and elimination of secondary causes of bone loss, well-designed exercise programs that include balance, strength and endurance training significantly reduce risk of falls and associated fractures. 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 significantly increase strength, function, and quality of life in patients with fragility fracture.

Weight-bearing exercise increases bone density at the spine and hip. Caution is necessary to prevent fracture in patients with significantly low bone mass or previous fractures. Benefits can also be obtained with lower-impact, moderate intensity exercise once or twice a week.

The slow-movement martial arts exercise, Tai Chi, has been shown to improve strength and balance, and significantly reduce falls. 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.⁵³

BONE-SAFE BODY MECHANICS

For people with fragile bones or a history of fractures, safety is a primary concern. Avoiding injury become an impediment to participation in exercise and activities of daily life (ADLs), leading to greater disability and social isolation. Osteoporotic patients of all ages should be encouraged to get active and stay safe at the same time. Adapting ADLs and recreational activities for bone safety can be a challenge. It requires rethinking and relearning habitual behaviors, from climbing stairs to getting out of bed.

In fact, how a person performs typical daily tasks, such as sweeping, climbing stairs, or unloading a clothes dryer, is predictive of future fracture risk, as demonstrated through research on performance-based tests of physical function. In the Safe Functional Movement (SFM) study, balance, flexibility, vision, and spinal loading were assessed during the performance of standardized everyday activities and evaluated for their impact on falls and fractures, both retrospectively (from patient records) and prospectively (follow-up of three years). Higher safe-movement scores were associated with lower rates of falls and fractures at both the spine (prevalent and incident) and hip (prevalent). For each score 10 points higher on the SFM test, a participant had 18% lower vertebral fracture risk at one-year follow-up and 27% lower risk at three years.

While it is possible to teach basic principles of safe body mechanics in a typical office visit, patients with osteoporosis or a prior vertebral fracture will benefit from referral to trained physical and occupational therapists and exercise classes with instructors experienced in working with older people and individuals with osteoporosis. The American Board of Physical Therapy Specialties offers certification to qualified physical therapists who specialize in geriatrics. Patients can find a board-certified geriatric physical therapist in their area through the public portal on the American Physical Therapy Association's website (apta.org).

Handouts illustrating spine-safe ways of doing things can be sent home with patients or emailed to them following an office visit. (See examples in this Toolkit.)

SAFETY CONCERNS: EXERCISES AND ACTIVITIES TO AVOID

Proper alignment is key to safe movement. Alignment of the head, shoulders, spine, hips, knees and ankles centers the body's mass over the lower extremities, distributing skeletal load. The following positions and/or movements should be avoided in patients with bone fragility:

- Slouching, with head forward, collapsed trunk (rather than upright), and hips forward
- Bending forward from the waist
- Twisting at the spine (turn at waist, shoulders rotate, hips don't)
- Wisting the trunk and/or bending forward when doing activities such as coughing, sneezing, vacuuming or lifting

For people with osteoporosis, the harm or benefit conferred by exercise depends on the specific movement involved. Exercises that require spinal flexion (forward bending) increase risk of vertebral fracture over no exercise, while exercises that involve spinal extension decrease risk.

Conventional ways of doing many ADLs can put excessive stress on spinal vertebrae, things like picking up a pet, tying shoes, and scrubbing a bathtub. By the same token, some exercises can do more harm than good. Individuals with low bone density, osteoporosis, or spinal kyphosis should engage in exercises with a straight or supported back. Exercises that require flexion (forward bending under stress) should be avoided, such as sit-ups and abdominal crunches or bench presses

High-impact, weight-bearing exercises help build bones and keep them strong. However, they can cause injury in individuals with vertebral fractures. Risky sports and leisure activities such as parasailing, down-hill skiing, and sky diving are obvious activities to avoid, as should any activity involving jerky, rapid movements, high-velocity impacts, and forceful bending and twisting. Some of these activities are lifelong pastimes for patients. It can be devastating to have to give them up. Ensuring that patients understand the potential consequences of risky recreational activities enables them to make informed choices. Potentially harmful for individuals with low bone mass and vertebral fractures include: golf, tennis, racquet ball, bowling, and some poses in yoga that require twisting at waist and/or forward bending.

ACTIVITY RECOMMENDATIONS FOR PEOPLE WITH OSTEOPOROSIS AND/OR FRACTURES

Although beneficial to overall health and bone density, aerobic exercise, such as walking, may not be sufficient to prevent falls and fractures in people with osteoporosis. Data from observational studies indicates that patients benefit most when aerobic exercise is accompanied by balance training and muscle strengthening exercises focused on building lower extremity and postural muscles.¹

Exercises that strengthen the lower extremities reduce risk of falling and may prevent consequent fractures. Non-impact balance and posture exercises protect the spine against injury in daily activities and reduce the risk of falls. Some of these exercises include:

- Lifting weights using back-safe position and technique.
- Pulling elastic exercise bands.
- Using weight machines.
- Lifting one's own body weight, such as one-foot stands and toe rises.
- Balance exercises that strengthen legs and challenge balance, such as Tai Chi or slow/controlled dancing.
- Posture exercises that strengthen back extensor muscles.
- Functional exercises focused on safely performing everyday activities, such as climbing stairs

Consultation with a trained physical therapist and/or participation in group exercises led by trained personnel help ensure patient safety.

Sticking with any lifestyle change can be difficult. However, persistence is easier when that change is linked to something of value to a person. In this case, what probably matters most is preserving independence by preventing injury that results in nursing home admission. Research has shown death to be preferable to loss of independence for many elderly people.

Table 9. Exercise Recommendations

WEIGHT-BEARING EXERCISES	30 minutes on most days of the week. A 30-minute session or multiple sessions spread out throughout the day.
MUSCLE-STRENGTHENING EXERCISES	Two to three days per week. Can be done all at once or in multiple short sessions, full body or one body part per day. (For example arms one day, legs the next and trunk the next.)
BALANCE, POSTURE AND FUNCTIONAL EXERCISES	Every day or as often as needed. Focus on area of most need: If patient has fallen, balance exercises should be emphasized. If patient's spine is bent, focus should be on posture exercises. If patient has trouble climbing stairs or getting up from the couch, he/she should do more functional exercises. These exercises can be performed at one time

Reprinted from "Exercise for Strong Bones" published online by the National Osteoporosis Foundation at nof.org. (NOF, 2015)

NEVER TOO OLD TO BENEFIT FROM EXERCISE

In older adults, exercise can lead to small but appreciable increases in muscle mass and bone density. These small improvements may have a disproportionately large impact on bone strength. How much of an impact has yet to be characterized. Studies are currently underway to better understand these effects.

Exercise trials for individuals with osteoporosis demonstrate benefits of multi-component, progressive high-intensity exercise programs that combine resistance and weight-bearing exercises.⁵⁴ Such programs have been shown to stimulate muscle synthesis, improve balance, gait, and endurance, and reduce falls. This applies to older people of all ages, from active community dwelling elders to sedentary nursing home residents. High-intensity exercise is not recommended for all people with age-related muscle wasting and/or bone loss.

Exercise and good nutrition are critical to the health of all people – even more important for individuals with bone loss and fractures. They are not, however, sufficient to preserve bone health and prevent fracture in people with osteoporosis. Pharmacologic antifracture therapy is necessary in addition to identification and correction of any modifiable causes of bone loss. Exercise and good body mechanics can improve quality of life and potentially extend fracture-free survival in people with osteoporosis and fractures. No matter how old or frail a patient is, the right kind of physical activity can build strength and improve function. Osteoporosis patients should be encouraged to pursue healthy physical activities that can safely be performed without overloading fragile bone.



SUMMARY OF CLINICIAN RECOMMENDATIONS

These recommendations apply to postmenopausal women and men age 50 and older.

PROMOTE BONE HEALTHY HABITS

- Counsel patients on the risk of osteoporosis and related fractures and their potential consequences (recurrent fractures, functional deterioration, increased mortality).
- Assess calcium intake. Advise that diet should include adequate amounts of total calcium intake (1000 mg per day for men 50-70; 1200 mg per day for women 51 and older and men 71 and older), incorporating dietary supplements if intake is insufficient.
- Assess serum vitamin D levels. Prescribe intake adequate to achieve and maintain serum sufficiency (≥ 30 ng/mL) and prescribe supplemental vitamin D (800-1000 units per day) as needed for individuals age 50 and older. (Higher doses may be necessary to attain serum sufficiency.)
- Recommend regular weight-bearing and muscle-strengthening exercise to improve agility, strength, posture and balance; maintain or improve bone strength; and reduce the risk of falls and fractures.
- Counsel patients on bone hazards of tobacco smoking and excessive alcohol intake and refer as appropriate.

EVALUATE FRACTURE RISK AND RULE OUT SECONDARY DISEASE

- Obtain a detailed patient history pertaining to clinical risk factors for osteoporosis-related fractures: broken bone as adult, glucocorticoid use, low BMI, etc.
- Perform physical examination and obtain diagnostic studies to evaluate for signs of osteoporosis and its rule out secondary causes.
- Perform clinical fall risk assessment: physical exam, medication review, fall history, postural hypotension, vision exam, and test gait, balance, and leg strength.
- Offer appropriate alternatives for modifiable risk factors: home safety evaluation, balance training exercises, correction of vitamin D insufficiency, avoidance of central nervous system depressant medications, monitoring of anti-hypertensive medications, and correction of conditions that impair vision).
- Use FRAX[®] to estimate patient's 10-year probability of hip and any major osteoporosis-related fracture.
- Perform BMD testing in:
 - Women age 65 and older and men age 70 and older.
 - Postmenopausal women and men age 50-69, based on risk factor profile.
 - Postmenopausal women and men age 50 and older who have had an adult-age fracture
- Ensure comparability of DXA results by conducting tests at:
 - DXA facilities using accepted quality assurance measures.
 - The same facility and on the same densitometry device for each test if possible.
- Vertebral fracture imaging (x-ray or DXA vertebral fracture assessment) should be performed in:

- Women age 70 and older and all men age 80 and older if BMD T-score is < -1.0 at the spine, total hip, or femoral neck.
- Women age 65 to 69 and men age 70 to 79 if BMD T-score is < -1.5 at the spine, total hip, or femoral neck.
- Postmenopausal women and men age 50 and older with specific risk factors:
 - Low-trauma fracture during adulthood.
 - Historical height loss of 1.5 inches or more (4 cm) (Defined as the difference between the current height and peak height at age 20).
 - Prospective height loss of 0.8 inches or more (2 cm) (Defined as the difference between the current height and a previously documented height measurement).
 - Recent or ongoing long-term glucocorticoid treatment.
- If bone density testing is not available, vertebral imaging may be considered based on age alone.
- Measure biochemical markers of bone turnover for risk assessment and benchmark for monitoring after treatment is initiated.

TREAT WITH APPROPRIATE ANTIFRACTURE MEDICATIONS

- Initiate pharmacologic treatment in:
 - Patients with fractures of the hip or vertebrae (clinical or asymptomatic).
 - Consider treatment in those with a wrist or humerus fracture and low bone mass (osteopenia).
 - Patients with T-scores < -2.5 at the femoral neck, total hip, or lumbar spine by dual-energy x-ray absorptiometry (DXA).
 - Postmenopausal women and men age 50 and older with low bone mass (T-score between -1.0 and -2.5 [osteopenia]) at the femoral neck, total hip, or lumbar spine by DXA and a 10-year hip fracture probability > 3% or a 10-year major osteoporosis-related fracture probability > 20% based on the U.S.-adapted absolute fracture risk model FRAX[®] (www.NOF.org and www.shef.ac.uk/FRAX).
- Currently FDA-approved pharmacologic options for osteoporosis are bisphosphonates (alendronate, ibandronate, risedronate and zoledronic acid), calcitonin, estrogen agonist/antagonist (raloxifene), estrogens and/or hormone therapy, tissue-selective estrogen complex (conjugated estrogens/bazedoxifene), parathyroid hormone 1-34 (teriparatide), parathyroid hormone-related peptide PTHrP [(1-34)] analog (abaloparatide), and RANK ligand inhibitor (denosumab).

FOLLOW UP AND MONITOR TREATMENT

- Measure height annually, preferably with a wall-mounted stadiometer.
- Patients taking FDA-approved medications should have laboratory and bone density re-evaluation after two years or more frequently when medically appropriate.

- Patients who do not require medical therapies at the time of initial evaluation should be clinically re-evaluated when medically appropriate.
- Vertebral imaging should be done if there is documented height loss, new back pain, postural change, or suspicious finding on chest x-ray.
- Vertebral imaging should also be performed in patients being considered for a temporary cessation of drug therapy to make sure no new vertebral fractures have occurred while on treatment.
- Regularly, and at least annually, assess adherence with the therapeutic regimen. Solicit and address patient concerns. Communicate risk-benefit trade-offs to patient and confirm that these are understood. Make changes to management plan as needed.

SUPPORT RECOVERY IN POST-FRACTURE PATIENTS

- Manage pain following fracture: encourage activity, prescribe limited bed rest, physical and occupational therapy, over-the-counter NSAID analgesia, as well as heat/ice, acupuncture/massage, meditation, and other nonpharmacologic pain mitigation techniques. In cases of intractable or chronic pain, refer to physiatrist, physical therapy, or pain specialist.
- Encourage patients to stay active. Counsel patients on the role of exercise and safe body mechanics in fracture prevention. Refer for physical therapy and home fall risk evaluation and remediation.
- Monitor patients for depression and diminished quality of life. Refer as needed to counseling and/or social support.
- For patients with painful acute vertebral fractures, consider surgical referral and assessment for vertebroplasty or kyphoplasty.

NOTE TO EDITORS: THE following patient handout pages are picked up from the *OSTEOPOROSIS: CLINICAL UPDATES ISSUE: FRAGILITY FRACTURES: THE IMPACT OF MOVEMENT, EXERCISE, AND BODY MECHANICS*

Please use original PDF files – these are for position only.

FILENAME: 2018 EXERCISE FOR OSTEOPOROSIS

Check Your Risk for Falling

Please circle "Yes" or "No" for each statement below.		Why it matters	
Yes (2)	No (0)	I have fallen in the past year.	People who have fallen once are likely to fall again.
Yes (2)	No (0)	I use or have been advised to use a cane or walker to get around safely.	People who have been advised to use a cane or walker may already be more likely to fall.
Yes (1)	No (0)	Sometimes I feel unsteady when I am walking.	Unsteadiness or needing support while walking are signs of poor balance.
Yes (1)	No (0)	I steady myself by holding onto furniture when walking at home.	This is also a sign of poor balance.
Yes (1)	No (0)	I am worried about falling.	People who are worried about falling are more likely to fall.
Yes (1)	No (0)	I need to push with my hands to stand up from a chair.	This is a sign of weak leg muscles, a major reason for falling.
Yes (1)	No (0)	I have some trouble stepping up onto a curb.	This is also a sign of weak leg muscles.
Yes (1)	No (0)	I often have to rush to the toilet.	Rushing to the bathroom, especially at night, increases your chance of falling.
Yes (1)	No (0)	I have lost some feeling in my feet.	Numbness in your feet can cause stumbles and lead to falls.
Yes (1)	No (0)	I take medicine that sometimes makes me feel light-headed or more tired than usual.	Side effects from medicines can sometimes increase your chance of falling.
Yes (1)	No (0)	I take medicine to help me sleep or improve my mood.	These medicines can sometimes increase your chance of falling.
Yes (1)	No (0)	I often feel sad or depressed.	Symptoms of depression, such as not feeling well or feeling slowed down, are linked to falls.
Total _____		Add up the number of points for each "yes" answer. If you scored 4 points or more, you may be at risk for falling. Discuss this brochure with your doctor.	

*This checklist was developed by the Greater Los Angeles VA Geriatric Research Education Clinical Center and affiliates and is a validated fall risk self-assessment tool (Rubenstein et al. J Safety Res; 2011;42(6)493-499). Adapted by the CDC with permission of the authors for inclusion in the patient education pamphlet: Stay Independent: Falls are the main reason why older people lose their independence. Are you at risk? Part of the STEADI (Stopping Elderly Accidents, Deaths & Injuries) Tool Kit for Health Care Providers

Available at: http://www.cdc.gov/homeandrecreationalafety/pdf/steady/stay_independent.pdf Accessed February 2015.

Patient: _____ Date: _____ Time: _____ AM/PM

The 4-Stage Balance Test

Purpose: To assess static balance

Equipment: A stopwatch

Directions: There are four progressively more challenging positions. Patients should not use an assistive device (cane or walker) and keep their eyes open.

Describe and demonstrate each position. Stand next to the patient, hold his/her arm and help them assume the correct foot position.

When the patient is steady, let go, but remain ready to catch the patient if he/she should lose their balance.

If the patient can hold a position for 10 seconds without moving his/her feet or needing support, go on to the next position. If not, stop the test.

Instructions to the patient: I'm going to show you four positions.

Try to stand in each position for 10 seconds. You can hold your arms out or move your body to help keep your balance but don't move your feet. Hold this position until I tell you to stop.

For each stage, say "**Ready, begin**" and begin timing.

After 10 seconds, say "**Stop.**"

See next page for detailed patient instructions and illustrations of the four positions.

For relevant articles, go to: www.cdc.gov/injury/STEADI



Centers for Disease
Control and Prevention
National Center for Injury
Prevention and Control

STEADI Stopping Elderly
Accidents, Deaths & Injuries

Instructions to the patient:



1. Stand with your feet side by side.

Time: _____ **seconds**



2. Place the instep of one foot so it is touching the big toe of the other foot.

Time: _____ **seconds**



3. Place one foot in front of the other, heel touching toe.

Time: _____ **seconds**



4. Stand on one foot.

Time: _____ **seconds**

An older adult who cannot hold the tandem stance for at least 10 seconds is at increased risk of falling.

Notes:

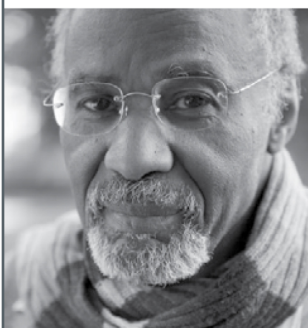
Patient: _____ Date: _____ Time: _____ AM/PM

The 30-Second Chair Stand Test

Purpose: To test leg strength and endurance

Equipment:

- A chair with a straight back without arm rests (seat 17" high)
- A stopwatch

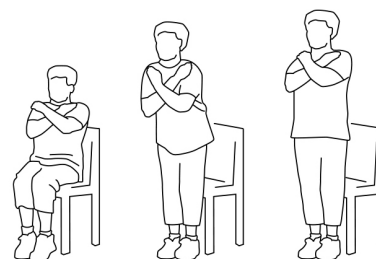


**CHAIR STAND
BELOW-AVERAGE
SCORES**

Age	Men	Women
0-65	<14	<12
5-69	<12	<11
0-74	<11	<10
0-84	<10	<9
5-89	<8	<9
0-94	<7	<4

Instructions to the patient:

1. Sit in the middle of the chair.
2. Place your hands on the opposite shoulder crossed at the wrists.
3. Keep your feet flat on the floor.
4. Keep your back straight and keep your arms against your chest.
5. On **"Go,"** rise to a full standing position and then sit back down again.
6. Repeat this for 30 seconds.



On **"Go,"** begin timing.

If the patient must use his/her arms to stand, stop the test. Record "0" for the number and score.

Count the number of times the patient comes to a full standing position in 30 seconds.

If the patient is over halfway to a standing position when 30 seconds have elapsed, count it as a stand.

Record the number of times the patient stands in 30 seconds.

Number: _____ **Score** _____ **See next page.**

A below average score indicates a high risk for falls.

Notes:

For relevant articles, go to: www.cdc.gov/injury/STEADI



Centers for Disease Control and Prevention
National Center for Injury Prevention and Control

STEADI Stopping Elderly Accidents, Deaths & Injuries

Patient: _____ Date: _____ Time: _____ AM/PM

The Timed Up and Go (TUG) Test

Purpose: To assess mobility

Equipment: A stopwatch

Directions: Patients wear their regular footwear and can use a walking aid if needed. Begin by having the patient sit back in a standard arm chair and identify a line 3 meters or 10 feet away on the floor.



Instructions to the patient:

When I say **"Go,"** I want you to:

1. Stand up from the chair
2. Walk to the line on the floor at your normal pace
3. Turn
4. Walk back to the chair at your normal pace
5. Sit down again

On the word **"Go"** begin timing.

Stop timing after patient has sat back down and record.

Time: _____ seconds

An older adult who takes ≥ 12 seconds to complete the TUG is at high risk for falling.

Observe the patient's postural stability, gait, stride length, and sway.

Circle all that apply: ■ Slow tentative pace ■ Loss of balance
■ Short strides ■ Little or no arm swing ■ Steadying self on walls
■ Shuffling ■ En bloc turning ■ Not using assistive device properly

Notes:

For relevant articles, go to: www.cdc.gov/injury/STEADI



Centers for Disease
Control and Prevention
National Center for Injury
Prevention and Control

STEADI Stopping Elderly
Accidents, Deaths & Injuries

Calcium-Rich Foods Patient Handout

Calcium-Rich Food, serving size	Calcium (mg)
Fortified oatmeal, 1 packet	350
Sardines, canned in oil, with edible bones, 3 oz.	324
Cheddar cheese, 1 1/2 oz. shredded	306
Milk, nonfat, 1 cup	302
Milkshake, 1 cup	300
Yogurt, plain, low-fat, 1 cup	300
Soybeans, cooked, 1 cup	261
Tofu, firm, with calcium, 1/2 cup	204
Orange juice, fortified with calcium, 6 oz.	200-260 (varies)
Salmon, canned, with edible bones, 3 oz.	181
Pudding, instant (chocolate, banana, etc.) made with 2% milk, 1/2 cup	153
Baked beans, 1 cup	142
Cottage cheese, 1% milk fat, 1 cup	138
Spaghetti, lasagna, 1 cup	125
Frozen yogurt, vanilla, soft-serve, 1/2 cup	103
Ready-to-eat cereal, fortified with calcium, 1 cup	100-1000 (varies)
Cheese pizza, 1 slice	100
Fortified waffles, 2	100
Turnip greens, boiled, 1/2	99
Broccoli, raw, 1 cup	90
Ice cream, vanilla, 1/2 cup	85
Soy or rice milk, fortified with calcium, 1 cup	80-500 (varies)

Source: U.S. National Institutes of Health. The Surgeon General's Report on Bone Health and Osteoporosis: What It Means to You. NIH Publication No. 12-7827. March 2013. Available at: http://www.niams.nih.gov/Health_Info/Bone/SGR/surgeon_generals_report.asp#s. Accessed February 13, 2014.

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Accidents, Deaths & Injuries

RESOURCES

How to Safely Do Everyday Activities (video)

Patient education published by Osteoporosis Canada. Online at: <http://www.osteoporosis.ca/after-the-fracture/videos/>

www.nof.org (website)

National Osteoporosis Foundation's website makes available a wide range of publications for patients

- Protecting Your Fragile Spine
(Signs and symptoms of spine fractures and how to prevent them)
- Skeletal Fitness II (video)
The new Skeletal Fitness II DVD by Mirabai Holland features safe exercises for people with and at-risk for osteoporosis exercise safely to protect their bones.

Move Forward™

Patient education website of the American Physical Therapy Association (APTA) from which one can access information on osteoporosis and physical therapy including exercise videos. (www.moveforwardpt.com)

Stand Tall (video)

For-purchase video produced by the APTA's Academy of Geriatric Physical Therapy. Available at www.geriatricpt.org/store/

WARNING! Proceed with Caution

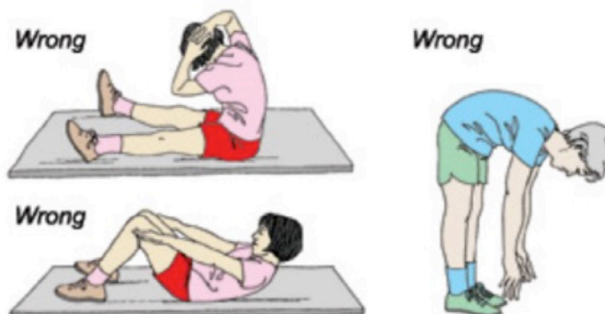
Some exercises can do more harm than good. If you have osteoporosis or have had broken bones in your spine, you should avoid exercises that involve bending over from the waist. Some examples include:

- Sit-ups
- Abdominal crunches (also referred to as stomach crunches)
- Toe-touches

Many exercises and activities such as yoga, Pilates, tennis, and golf may need to be avoided or modified because they often involve twisting and bending motions.

Research has demonstrated that sudden impact (such as hitting a ball) during movement is especially risky for fragile bones, as is pushing all the way to the fullest extent of a person's range of motion.

Bending forward during routine activities puts stress on the spine and can raise the chance of breaking a bone in the spine. While bending forward strains the spine, it can be made safer by keeping your back flat and bending at the hips.



-
- When tying your shoes or drying your feet, sit in a chair. Place one foot on your other leg, a box or footstool.
 - Lean forward at the hips to tie or dry. Do not slouch or bend over or round your upper back. Keep the natural curve of your lower back.

Bone-Safe Tips for Stair Climbing

- Use the stairs for exercise only if your healthcare provider says it's safe for you. Build up gradually with this exercise.
- Keep your head high, chin in, shoulder blades slightly pinched together and abdomen pulled in.
- Keep your feet pointed straight ahead. Your knees should face forward and be slightly bent.
- Instead of putting one foot directly in front of the other, keep your feet a few inches apart, lined up under your hips.
- For safety, hold the rail while going up and down but try to avoid pulling yourself up by the railing.
- Be especially cautious going downstairs. A fall down the stairs could cause severe injuries.



Bone-Safe Tips for Lifting and Carrying

- Don't lift or carry anything heavier than 10 pounds. If you are unsure about how much you can lift, check with your healthcare provider or physical therapist.
 - If you do pick up a heavy object, never bend so far over that your back is parallel to the ground. This places a great deal of strain on your back.
 - To lift an object from the floor, first kneel on one knee. Place one hand on a table or stable chair for support if you need it. Bring the object close to your body at waist level. Gently tighten your abdomen in to support your back and breathe out as you rise to standing. Do not hold your breath. Stand using your leg and thigh muscles.
 - When carrying groceries, ask to have your bags packed lightly. Divide heavy items into separate bags. Always hold bags close to your body. Try to balance the load by carrying the same amount in each hand.
 - When unpacking, place bags on a chair or table rather than on the floor or on a high countertop. This prevents unnecessary lifting and twisting.
 - Instead of carrying a heavy briefcase, tote bag, or purse, consider wearing a fanny pack or using a rolling bag.
-

Bone-Safe Lying in Bed

- When lying on your side in bed, use one pillow between your knees and one under your head to keep your spine aligned and maximize your comfort.
- When lying on your back in bed, use one or two pillows under your knees and one under your head. Try to avoid using extra pillows to prop your head and upper back since this will put you into a rounded upper-back position. But, if you already have a rounded upper back posture with a forward head, you may need two pillows to support your neck comfortably.



Bone-Safe Getting out of Bed

- When on your back, never lift your head and upper back to sit up in bed or get out of bed.
- Keep both arms in front of you.
- Pull your abdomen in and breathe as you roll onto your side.
- Keep your abdomen pulled in and use your hand to raise your upper body as you carefully place your legs over the side of the bed in one motion.
- Sit on the edge of the bed for a moment or two before you stand up.

Bone-Safe Tips for Coughing and Sneezing

- Develop the habit of supporting your back with one hand whenever you cough or sneeze.
- Place your hand behind your back or on your thigh. This protects the spine from injury caused by a sudden bend forward.

Right



Right



Wrong



RESOURCES

How to Safely Do Everyday Activities (video)

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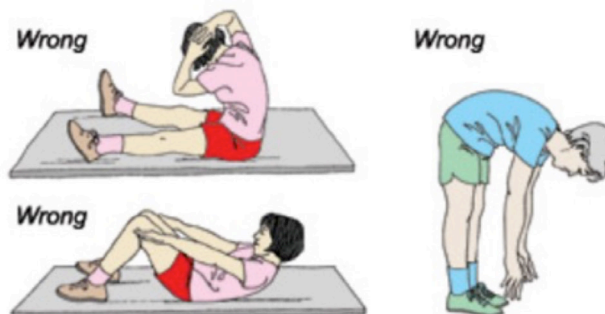
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- Sit-ups
- Abdominal crunches (also referred to as stomach crunches)
- Toe-touches

Many exercises and activities such as yoga, Pilates, tennis, and golf may need to be avoided or modified because they often involve twisting and bending motions.

Research has demonstrated that sudden impact (such as hitting a ball) during movement is especially risky for fragile bones, as is pushing all the way to the fullest extent of a person's range of motion.

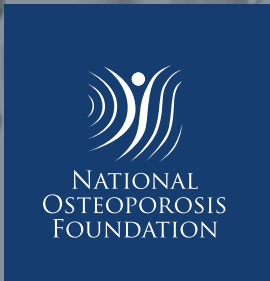
Bending forward during routine activities puts stress on the spine and can raise the chance of breaking a bone in the spine. While bending forward strains the spine, it can be made safer by keeping your back flat and bending at the hips.



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Special thanks to Medtronic for support of the Healthcare Provider Toolkit in printed and online versions.