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Osteop

fragility fractures, and associated surgeries

By Eileen Dickinson, BSN, RN, CNOR

The word osteoporosis literally means "porous bones." It occurs when bones lose an excessive amount of their protein and mineral content. Osteoporosis is called the "silent disease" because it progresses without symptoms until a fracture occurs. Osteoporosis is a serious public health problem. It's estimated that 10 million people in the United States have this potentially debilitating disease. In addition, 33.6 million Americans have low bone mass, placing them at increased risk for developing osteoporosis. Because of osteoporosis, approximately half of all women over the age of 50 will suffer a fracture of the hip, wrist, or vertebra during their lifetime.[1] Although often considered a "women's disease," osteoporosis affects approximately 2 million men in the United States.[2]

Types

Osteoporosis has four classifications. The disease is considered primary if no other mechanism or disorder can be identified as the cause for bone loss. Primary osteoporosis is further characterized into either type I or type II. Type I osteoporosis (postmenopausal osteoporosis) is the excessive loss of trabecular bone and generally develops in women after menopause when the amount of estrogen in the body greatly decreases. Type II osteoporosis (senile osteoporosis) is the loss of both trabecular and cortical bone, and is an age-related disease. Osteoporosis is considered secondary if the bone loss occurs because of a

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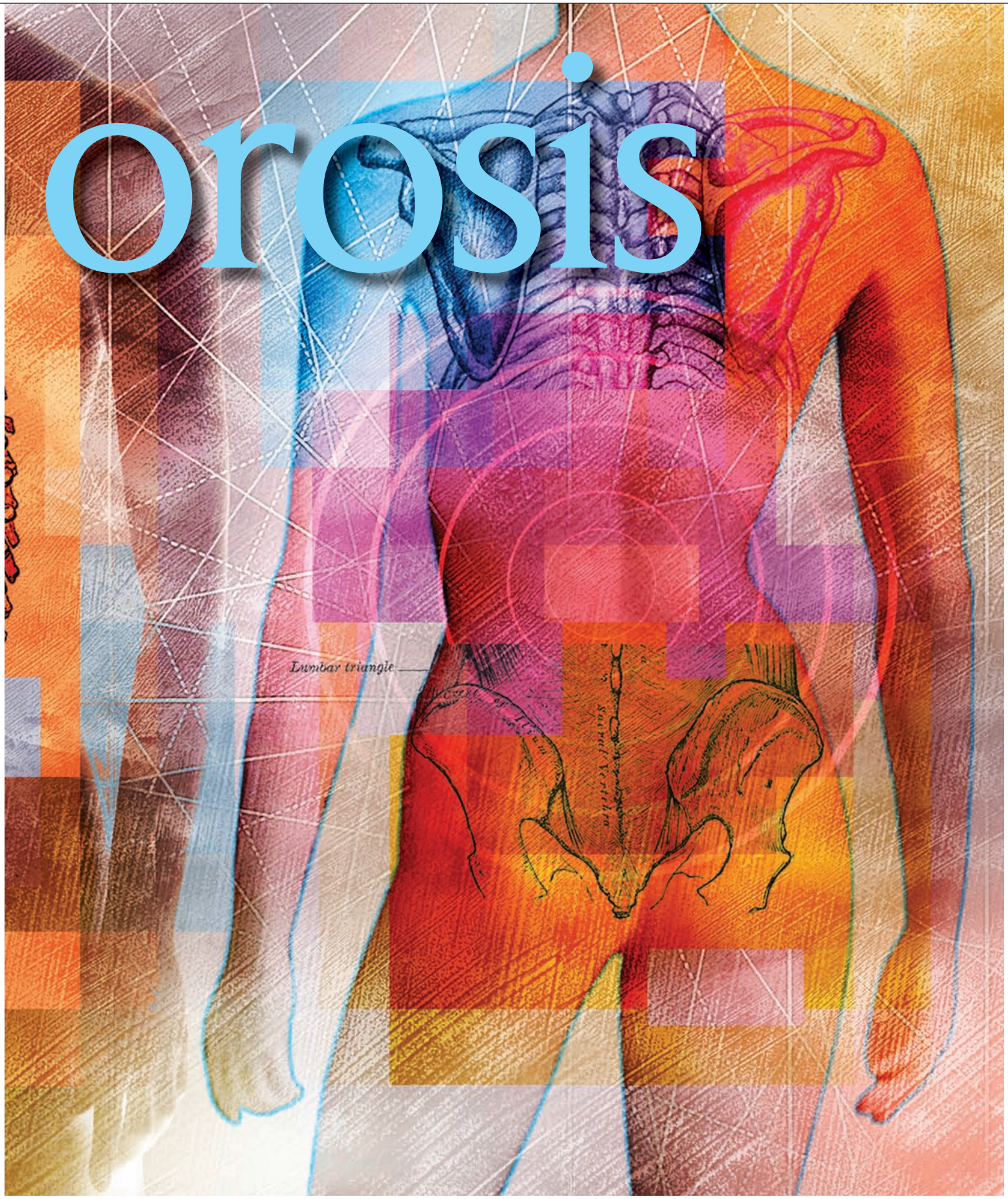


previous existing condition, such as inflammatory disorders, or the use of certain medications.[3] Chronic corticosteroid use is the most common drug-related cause of secondary osteoporosis in men. The other two classifications affect infants and children.[4]

Risk factors

There are a number of genetic and lifestyle factors that place individuals at greater risk of developing osteoporosis. There are some risk factors that can be changed and others that can't. The two most significant risk factors that can't be changed include age and female gender.[5] Although bone loss can occur at any age–particularly in response to certain diseases or medications–osteoporosis is far more common in older adults than in the young. It's also far more common in women than in men. In fact, 80% of people with osteoporosis are women. Young men have bone mass levels approximately 5% to 10% greater than young women.[6] Gender differences in peak bone mass may be related in part to gender differences in periosteal bone apposition during puberty. Higher androgen levels result in greater periosteal apposition in adolescent males, and higher estrogen levels in adolescent females inhibit periosteal bone apposition.[6]

Osteoporosis is also more likely in individuals with family members who have the disease as well as in White and Asian women. Other risk factors include late onset of puberty and early onset of menopause or removal of the ovaries, which causes low levels of estrogen. Low body weight (weight less than 127 lb [57.6 kg] or BMI less than or equal to 20) can also be a contributing factor. Low testosterone level in men is also a risk factor for osteoporosis. Certain medical conditions including a variety of genetic, endocrine, gastrointestinal, hematologic, rheumatologic, autoimmune disorders, along with sickle cell disease, and some cancers are associated with an increased risk for osteoporosis. Long-term use of certain medications, including corticosteroids, heparin, lithium, proton pump inhibitors, chemotherapeutic agents, selective serotonin reuptake inhibitors, and some antiepileptic drugs leads to bone loss and increased risk of osteoporosis.[7]

Lifestyle factors that can increase the risk of developing osteoporosis include improper diet–particularly one high in protein, sodium, or caffeine–and low in calcium and vitamin D. Nutrition plays an important part in the alteration of peak bone mass. In addition, women who are inactive or don't participate in regular weight-bearing and resistive exercise are more likely to develop osteoporosis. Other modifiable risk factors include cigarette smoking and excessive alcohol use. The risk of a fracture for individuals diagnosed with osteoporosis is four times greater than those who do not have it.[6] Older adults account for more than 50% of hospitalized patients with fractures, and osteoporosis-related fractures are responsible for substantial economic costs.[8-10] (See *Economic cost of osteoporosis.*)

Economic cost of osteoporosis[1,8-10]

Every year, 1.5 million Americans suffer a fracture secondary to bone disease. Approximately one-third of these patients require hospitalization, making the fracture the most common musculoskeletal cause of hospitalization in the Medicare population. The National Hospital Discharge Survey found that patients age 65 and older accounted for more than half of the hospitalizations for fractures. Osteoporosis-related fractures create a substantial economic burden, resulting in more than 432,000 hospital admissions, almost 2.5 million medical office visits, and about 180,000 skilled nursing facility admissions annually in the United States. The cost to the healthcare system associated with osteoporosis-related fractures is estimated to increase over the next decade to a cost of over $25 billion a year.

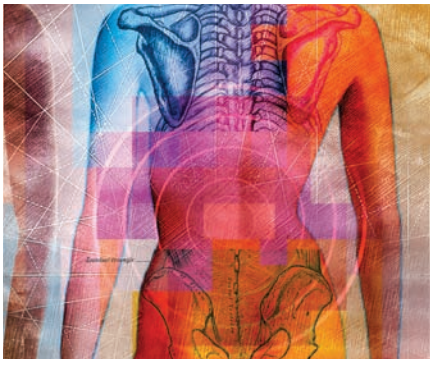
Diagnosis

Diagnosing osteoporosis involves several steps, starting with a careful medical history and a physical exam, blood (such as a complete blood cell count, comprehensive metabolic panel, thyroid-stimulating hormone) and urine (such as a 24-hour urinary calcium) tests to rule out secondary causes of osteoporosis, and a bone mineral density (BMD) assessment.[1] Mineral complexes are what give hardness to bones, and the density of mineral in bones is an important determinant of bone strength. BMD testing can be used to definitively diagnose osteoporosis, detect low bone mass before osteoporosis develops, and help predict risk of future fractures. The diagnosis of normal, low bone mass (osteopenia), osteoporosis, and severe or established osteoporosis is based on the World Health Organization diagnostic

classification. A T-score of -1 or above is considered normal, between -1 and -2.5 indicates low bone mass, and a score of -2.5 or lower indicates osteoporosis. The greater the negative number, the more severe the osteoporosis.[1,11]

The most widely recognized test for measuring BMD is a quick, painless, and noninvasive technology known as dual-energy X-ray absorptiometry (DXA). This technique, which uses trivial amounts of radiation, involves passing a scanner with two X-ray beams over the body while the patient is lying on a cushioned table. DXA can be used to determine BMD of the entire skeleton and at various sites that are prone to fracture, such as the hip, spine, or wrist. Bone density measurement via DXA at the hip and spine is the best and most reliable way to diagnose osteoporosis, predict fracture risk, and monitor patients by performing serial assessments.[12]

Quantitative computed tomography (QCT) can also be used to diagnose patients with osteoarthritis. QCT is unique in its ability to distinguish trabecular bone from cortical bone and to provide individual density readings for each in addition to providing a true volumetric mineral density value. Furthermore, other tests can be used to measure bone density. These include peripheral DXA and quantitative ultrasound, which are most commonly used as screening tools to determine if more extensive imaging is needed.[13]



Osteoporosis treatment is aimed at preventing or reducing bone fractures and maintaining or increasing bone density.

Prevention and treatment

Osteoporosis treatment is aimed at preventing or reducing bone fractures and maintaining or increasing bone density. There are several treatments for osteoporosis, but prevention is still very important. Interventions include diet, exercise, fall prevention, and medications.

Maintenance of good bone strength requires a regular intake of calcium and vitamin D. The National Osteoporosis Foundation (NOF) adult recommendations for calcium intake state that women age 50 and younger and men age 70 and younger should consume 1,000 mg of calcium daily; women age 51 and older and men age 71 and older should consume 1,200 mg of calcium daily.[1,14] NOF recommends vitamin D in daily doses of 800 to 1,000 international units for adults age 50 and older and vitamin D in daily doses of 400 to 800 international units for adults under age 50.[1,14] Exercising regularly builds and strengthens bones. An effective way to strengthen bones is with weight-bearing exercises. These include aerobics, walking, tennis, jogging, dancing, and weight lifting.[1] Patients with osteoporosis should start with gentle exercise, such as walking or swimming, rather than jogging or fast–paced aerobics, which may increase the risk of falling. Exercising three to four times per week for 20 to 30 minutes is most effective. Multifactorial interventions to reduce the risk of falls include an individual risk assessment, a home safety assessment (conducted by an occupational therapist), and home modifications, adding Tai Chi to the physical activity routine, vision correction as needed, and a gradual withdrawal of psychotropic medication when medically appropriate.[1] Additional lifestyle changes to help prevent osteoporosis include smoking cessation and avoidance of excessive alcohol intake. Smoking and excessive alcohol intake (three or more drinks per day) are detrimental to bone health, and alcohol intake may increase the risks of falls.[1]

There are several classes of medications used to treat osteoporosis. Many of these medications can be used to prevent osteoporosis in patients who are at high risk. The main group of medications used is bisphosphonates (for example, alendronate, ibandronate, risedronate, and zoledronic acid).[1] These medications increase bone density, decrease fracture risk, and reduce bone breakdown. They function by interfering with the natural process of bone resorption. Selective estrogen receptor modulators (SERMs) (such as raloxifene) are used for both prevention and treatment of osteoporosis in postmenopausal women.[1] SERMS reduce bone resorption and decrease bone turnover. Estrogen therapy may be used at the lowest effective dose to prevent osteoporosis in postmenopausal women.[1]

Anabolic therapy with parathyroid hormone is indicated for patients with a very high risk for future fracture. Other treatment options include calcitonin and denosumab.[15] The prescriber needs to discuss the medication risks and benefits with the patient prior to starting any drug therapy. Patient education should include dosing instructions, potential drug interactions, possible adverse drug reactions including signs and symptoms to look for, and when to contact the prescriber.

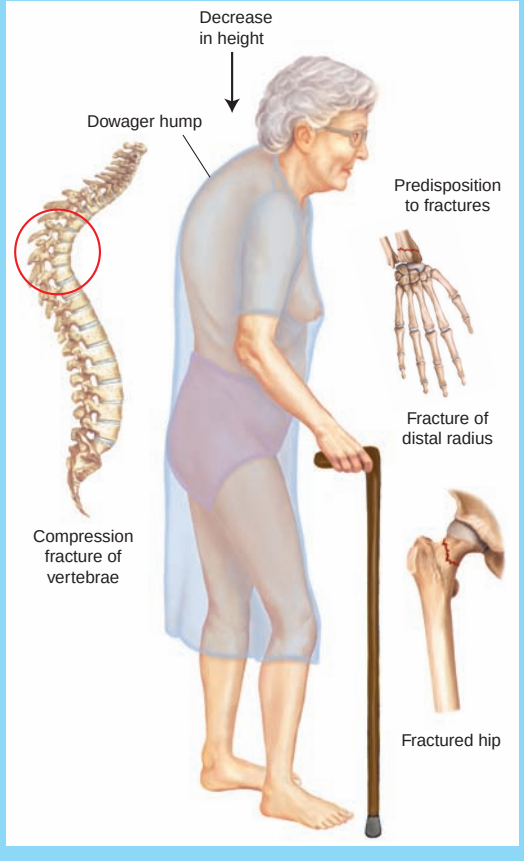
Fragility fractures and surgery

The clinical consequence of osteoporosis is fractures and their complications. (See *Clinical manifestations of osteoporosis.*) Fragility fractures are often the first sign of osteoporosis and low bone mass, which affects an estimated 57 million adults in the United States. Patients with a fragility fracture are at an increased risk of a second fracture. According to the NOF, a fragility fracture is any fall, from a standing height or less, that results in a fracture. The human body should be able to sustain a fall from this height, without a fracture, unless there is some underlying cause to suspect a bone disorder, like osteoporosis or osteopenia. Other fragility fractures are those that occur from minor body movement, like sneezing, coughing, stretching beyond arm's length, and rolling over in bed. The most common fragility fractures occur in the spine, wrist, and hip.

Unfortunately, much of the treatment for osteoporosis is for fractures that result from advanced stages of the disease. Hip fractures are a common complication of osteoporosis. They put the patients at risk for orthopedic complications and required surgeries associated with this condition. They also make patients more susceptible to deep vein thrombosis, pulmonary embolism, pneumonia, and other immobility issues, such as loss of muscle tone and strength. The risk of hip fracture associated with osteoporosis doubles after the age of 65 for both females and males. By 2050, the worldwide incidence of hip fracture is predicted to increase due to the aging of the population.[16] For complicated fractures such as hip fractures, hospitalization and surgical intervention are required. Approximately 20% of hip fracture patients require long-term, skilled nursing facility care, and only 40% fully regain their prefracture level of independence. The orthopedic goals of managing the fracture are to reestablish length, alignment, and stability. Osteoporotic patients with deficient bone are an extreme challenge for achieving stability. Surgical interventions such as pins, rods, plates, and screws frequently fail due to the insufficient bone quality, which is unable to support them. There are three different types of hip fractures: femoral neck, intertrochanteric, and subtrochanteric. Femoral neck fractures occur in the upper femur that lies between the rounded femoral head and trochanters. Most occur within the capsule that surrounds the hip joint and are therefore termed intracapsular. These fractures may cause a complication because the break usually cuts off the blood supply to the head of the femur, which forms the hip joint.

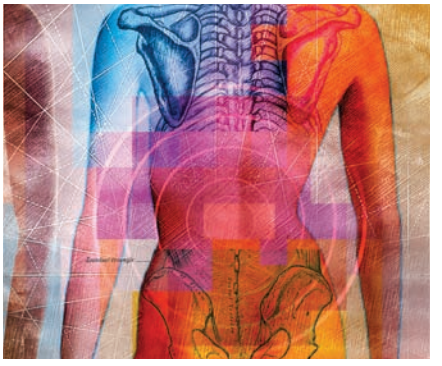
The intertrochanteric hip fractures occur more laterally than the femoral neck fractures, in the area

Clinical manifestations of osteoporosis



Source: Porth CM. *Essentials of Pathophysiology Concepts of Altered Health States. 3rd ed. Philadelphia,* PA: Lippincott Williams & Wilkins; 2011:1133.

between the greater trochanter and lesser trochanter. Intertrochanteric hip fractures occur outside of the joint capsule and are therefore extracapsular. Intertrochanteric fractures may be further grouped into stable and unstable fractures, depending on the location, number, and size of the fractured, bony segments. The proximal femur consists of the femoral head, femoral neck, and the trochanter region. An intertrochanteric hip fracture occurs between the greater trochanter and the lesser trochanter. This type of fracture doesn't interrupt the blood supply to the bone and may be easier to repair. Around 90% of hip fractures fall into these two categories in relatively equal numbers.[17]



Kyphosis is another serious osteoporosis complication in which vertebral fractures ultimately lead to spinal deformity, which can cause a curvature of the spine.

Subtrochanteric fractures occur at or distal to the proximal level of the lesser trochanter in the proximal portion of the femur. These fractures may include only a short, linear section of the proximal femur or may be part of a larger pattern that involves both the intertrochanteric and subtrochanteric sections of the femur. The blood supply to the bone of the subtrochanteric region is not as good as the blood supply to the bone of the intertrochanteric region, thus, healing occurs more slowly. Competing forces exerted by muscular attachments on the femur tend to pull the fractured fragments out of alignment.

Spinal instability is related to the aging population because of degenerative changes in their intervertebral disks and spinal facet joint capsules. Due to increased life expectancy, improved quality of life, and older adults' desire to remain physically active, surgical indications for degenerative spinal conditions such as spondylolisthesis and spinal stenosis have increased. Osteoporosis reduces bone quality through negative bone remodeling. Poor bone quality and low BMD can reduce the pullout strength of pedicle screws, and negative bone remodeling can cause delayed bone fusion. Therefore, surgeons are developing techniques to increase the pullout strength and enable positive bone remodeling, such as the technique to enhance the pullout strength of the pedicle screw. The preparation for screw hole or minimization of tapping the hole can affect the pullout strength in osteoporotic bone so that larger and longer screws provide a good solution for fragile bones. The angulations of two screws and screw positioning in areas with higher BMD in the vertebrae increase pullout strength. In addition, to improve the fixation and strength, screws are augmented with polymethylmethacrylate.[18]

Fractures of the vertebrae are usually a result of a compression fracture, typically caused by osteoporosis. This leads to a collapse of the vertebrae. Spinal vertebral fractures can occur without pain. However, they often cause a severe band-like pain that radiates from the spine around both sides of the body. Over many years, the spinal fractures cause loss of height of the spine, resulting in the person becoming shorter. A procedure called a vertebroplasty is performed to relieve pain, increase mobility, and protect the vertebrae from further collapse.

Vertebroplasty involves inserting bone cement into the center of the collapsed vertebrae in order to stabilize and strengthen the crushed bone. The cement is inserted with a needle and syringe through anesthetized skin into the midportion of the vertebrae under fluoroscopy. The cement then hardens, creating a cast-like effect.[19] (See *Vertebroplasty performed in the lumbar spine.*)

Kyphosis is another serious osteoporosis complication in which vertebral fractures ultimately lead to spinal deformity, which can cause a curvature of the spine. This can cause chronic back pain, and the internal organs become compressed due to the deformity, which can lead to breathing difficulties.

Kyphoplasty, like vertebroplasty, is a minimally invasive surgical procedure for treating osteoporotic fractures that uses bone cement inserted into the fractured vertebrae. However, kyphoplasty has an additional step. A balloon is gently inserted into the vertebrae where it creates a cavity that's then filled with cement to prevent further collapse.[20] (See *Kyphoplasty performed in the lumbar spine.*)

Preoperative

When a patient requires surgery for a fracture or has been previously diagnosed with osteoporosis, many factors need to be considered. Preoperative nursing considerations involve obtaining a complete history and physical, including the diagnosis of bone loss or osteoporosis, verifying that the patient has discontinued taking any osteoporosis medications that could cause medical conditions or adverse reactions (such as esophagitis from lying flat for an extended period of time), and assess for fall risks while completing the presurgical assessment.

Reduction of injury related to falls has been established by the Joint Commission as a National Patient Safety goal.[21] Fall risks should be assessed on all surgical patients during the preoperative assessment. Patients deemed to be high risk should be carefully monitored throughout their perioperative period, and precautions should be taken when the risk of falling increases.

A signed consent must be obtained before the patient is taken to the surgical suite acknowledging that the patient is aware of the risks and complications, that they know they will be receiving anesthesia, and that the surgeon has explained the surgical procedure to them. The perioperative nurse should confirm that the patient has received appropriate preoperative teaching in preparation for the surgery.

Pain management is usually the main concern for patients having surgery. Preoperative instruction should include information about pain management modalities that the patient will be utilizing postoperatively. Patients should be encouraged and instructed to ask for or take pain medication before the pain becomes unbearable and should be taught how to rate their pain on a pain scale. This allows nurse assessing them to evaluate the pain consistently.

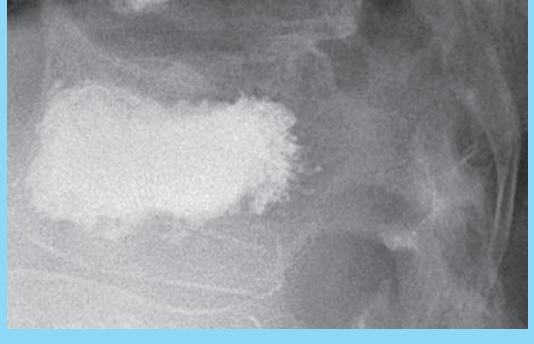
Surgical site infections are associated with prolonged hospital stays and increased cost. To reduce the incidence of postoperative wound infections, especially in patients undergoing procedures involving implantation of prosthetic devices, patients receive prophylactic antibiotic therapy.

Intraoperative

The circulating nurse should make all of the surgical team members aware of the patient's diagnosis of low bone mass or osteoporosis during the "time out" so that special precautions can be taken when needed to reduce the patient's risk for injury.

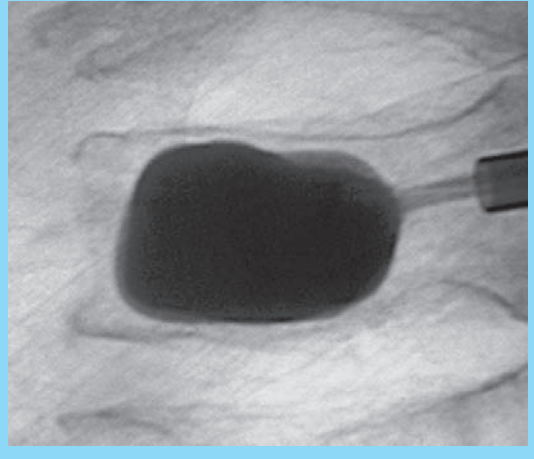
Proper positioning of the surgical patient is necessary to provide the best surgical access while minimizing potential risk to the patient and to prevent postoperative complications, such as pressure injuries, neuropathies, and cardiovascular/respiratory compromises. Special care must be taken when positioning the patient in lateral or prone position to eliminate the risk of fracture, falling, or other trauma. The use of positioning devices such as gel pads

Vertebroplasty performed in the lumbar spine



Bucholz RW, Court-Brown CM, et al. *Rockwood and Green's Fractures in Adults*. 7th ed. Philadelphia, PA: Wolters Kluwer Health/ Lippincott, Williams, & Wilkins; 2010:510.

Kyphoplasty performed in the lumbar spine

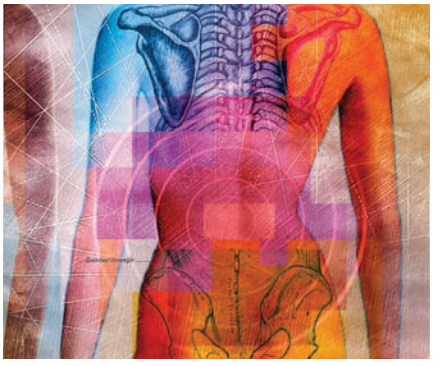


Bucholz RW, Court-Brown CM, et al. *Rockwood and Green's Fractures in Adults*. 7th ed. Philadelphia, PA: Wolters Kluwer Health/ Lippincott, Williams, & Wilkins; 2010:510.

around bony prominences and pillows between legs should be used to reduce the risk of injury. Special precautions also need to be taken when transferring the patient from the stretcher to the OR bed and back because typical precautions may not be sufficient for patients with weak and fragile bones. Using a transfer device and adequate personnel with a slow, smooth, synchronized motion will aid in the reduction of injury to the patient. The circulating nurse is responsible for coordinating the team and executing these actions.

If the need for CPR should develop during the procedure, resuscitation team members need to be made aware of the patient's osteoporosis diagnosis so they can try to prevent fractures of the ribs, sternum, and other bones that may be affected by the CPR procedure.[1]

Many surgical patients are not aware that they have low bone mass or osteoporosis. In many cases, the surgeon discovers this during surgery. The circulating nurse documents and communicates intraoperative findings to help facilitate proper follow-up care.



The American Academy of Orthopaedic Surgeons advocates for osteoporosis evaluation and treatment after fracture surgery so patients are not discharged without the appropriate follow-up care.

Postoperative

The American Academy of Orthopaedic Surgeons advocates for osteoporosis evaluation and treatment after fracture surgery so patients aren't discharged without appropriate follow-up care.[22] Treatment for osteoporosis may not change the immediate problem of a fracture but can benefit future health concerns.

Hardware failure and delayed healing are common complications for patients with osteoporosis. If the bone around the hardware is thin and the remodeling process has decreased, then the surgical site may not heal. Since orthopedic surgeons are usually the first physicians to assess and treat the patient after a fragility fracture, their role doesn't end when the procedure is over. They should ensure that measures are implemented using a multidisciplinary approach among allied healthcare professionals and that the patient receives proper follow-up care. High-quality postfracture care in terms of evaluation and appropriate medical treatment of osteoporosis, rehabilitation, lifestyle modifications, and secondary fall prevention should be provided for optimal functional recovery, reduction of future fracture risk, and improvement of overall quality of life. Rehabilitation improves the functional outcome in patients after an osteoporotic fracture by reducing the level of disability and maintaining the level of mobility.[23] However, physical and occupational therapists need to know about the diagnosis so they don't cause any injury to the patient or negatively affect the surgical outcome.

New medications the patient may need to take after surgery, such as corticosteroids and pain medication, can complicate the healing process and can cause bone loss. Patients need to be informed of this adverse reaction so appropriate follow up to monitor for bone loss with a BMD scan can be conducted. Pain management can best be accomplished with opioid and nonopioid medications, positioning, and ice.

Moving forward

As populations are aging, osteoporosis and related fractures are becoming a very prevalent trauma condition. Therefore, these fractures represent a major public and healthcare problem, as they're associated with high rates of morbidity, disability, pain, mortality, and high cost. Due to this high prevalence, perioperative nurses and the OR team will see more patients with this disease. The surgical team and perioperative nurses need to take special care when dealing with patients who have osteoporosis and fragile bones to prevent the risk of further injury. **OR**

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