ABSTRACT

- **Objective:** To review the diagnosis and treatment of osteoporotic vertebral compression fractures.
- **Methods:** Literature review.
- **Results:** Osteoporotic compression fractures of the spine are a relatively common cause of back pain, especially in elderly individuals. Approximately 700,000 new vertebral compression fractures occur in the United States every year. Pain is the most common presenting symptom and can occur anywhere in the spine, with the lower thoracic and upper lumbar regions being most common. An x-ray is often the simplest test that will confirm the presence of an osteoporotic compression fracture. They are best seen in the lateral view. Initial treatment of an osteoporotic compression fracture focuses on pain control and avoiding disability. For a wedge or stable burst fracture, heat, massage and relative rest are often beneficial. For unstable fractures, surgical intervention is often required. Vertebroplasty and kyphoplasty are 2 minimally invasive procedures that can be employed for osteoporotic compression fractures. In addition to treatment of the osteoporotic compression fracture, the clinician must look at treating the underlying osteoporosis. Physical medicine and rehabilitation intervention is an emerging therapy for osteoporosis management.
- **Conclusion:** For patients who have osteoporotic vertebral compression fractures, identification of the fracture and assessment of the type of fracture are essential to proper treatment. Very few osteoporotic vertebral compression fractures will require surgery. Treatment of the underlying osteoporosis is also essential for successful long-term patient functioning.

Osteoporosis is the most common bone disease in the world [1]. Although it is known as a “silent disease,” the main clinically relevant problem seen in patients with osteoporosis is fragility fractures, most commonly in the spine, proximal hip, and distal wrist. Osteoporotic compression fractures of the spine are a relatively common cause of back pain, especially in elderly individuals. Approximately 700,000 new vertebral compression fractures occur in the United States every year [2]. These fractures cause pain and often, disability. Unfortunately, they may also go undetected.

**CASE STUDY**

**Initial Presentation**

Mrs. T, a 72-year-old white female, presents for the first time to an orthopedic surgeon with back pain of several months’ duration.

**History**

Mrs. T was doing some gardening during the late spring. While pulling some weeds, she felt a “pop” in her mid-back followed by pain. She was unable to continue gardening and went inside to lay down. A few hours later, the pain was severe enough for her to go to her local emergency room. Examination by the emergency physician was performed and an x-ray of her thoracic spine was taken. The x-ray was negative for fractures, and the patient was discharged with a diagnosis of thoracolumbar strain and given prescriptions for a nonsteroidal anti-inflammatory and cyclobenzaprine. She was instructed to follow-up with her primary care provider within 3 days.

Two days later, she saw her family doctor, who discontinued the muscle relaxer due to sedative side effects and prescribed relative rest, ice, and/or heat as needed. Two weeks later, she still had back pain, and physical therapy was prescribed. This proved too painful for the patient, and she returned to her doctor. She was referred to an orthopedic spine surgeon for further treatment.

From Rockford Orthopedic Associates, Rockford, IL.
At the surgeon’s office, new x-rays of the thoracic and lumbar spine showed diffuse lumbar and lower thoracic spondylosis, degenerative disk disease, osteophytosis, and facet arthropathy. There was radiographic evidence for osteopenia and an anterior wedge compression fracture of the T11 vertebra. Comparison with the emergency room x-ray showed the compression fracture was not evident on the first film.

**How is osteoporosis defined?**

Osteoporosis is defined as bone mineral density (BMD) more than 2.5 standard deviations below the average BMD of healthy, 25-year-old, same-sex members of the population [1]. Most often, this is assessed by dual-energy x-ray absorptionometry (DEXA), a noninvasive radiographic technique that uses low-dose x-rays to calculate the bone density. Usually, the BMD at the hip and lower spine is used. This number is expressed in grams per centimeter squared (g/cm²). However, to make this clinically relevant, it is reported by Z-score and T-score. Z-score and T-score represent the standard deviations below normal. A Z-score is the value of BMD relative to age- and sex-matched individuals, while the T-score is that of “young adult” sex-matched individuals. In the elderly, the population most at risk for osteoporosis, the T-score is the preferred value for assessing clinical risk of fragility fracture. In younger adults, the Z-score may be more appropriate. Osteopenia is generally regarded as a T- or Z-score of −1.0 to −2.5 [1].

An osteoporotic vertebral compression fracture is classically one in which the anterior aspect of the vertebral bodies is compressed, while the posterior elements remain intact (Figure 1). This results in a “wedge” formation, as the anterior height (cranio-caudal) of the vertebral body is lower than that of the posterior height. There is no accepted definition of what height ratio or percentage difference from anterior to posterior qualifies as a compression fracture. There are other compression fractures, including those that can affect the middle and posterior elements of the spine, often referred to as “burst” fractures. Any of these fractures, including wedge fractures, can occur in nonosteoporotic individuals when subjected to sufficient force, such as a fall or high-velocity collision.

A fracture involving the posterior elements of the spine (lamina, pedicles, and facets most importantly) is considered an “unstable” fracture, usually requiring surgical intervention. These fractures present high risk for spinal cord or nerve root injury.

**Determining Future Fracture Risk**

The FRAX score, developed by the World Health Organization, uses clinical risk factors and BMD to assist physicians and patients in estimating future fracture risk [3]. The score can be calculated manually or by use of a simple online tool. The user enters the patient’s age, sex, height, weight, and bone density at the femoral neck and indicates yes or no regarding presence of risk factors such as previous fractures, smoking, and rheumatoid arthritis. The tool then calculates the 10-year probability of a major osteoporotic fracture. This can be helpful to the clinician and the patient in determining what form of osteoporosis treatment should be used and for educating the patient about the risks of untreated or undertreated osteoporosis.

**Risk Assessment in Case Patient**

Mrs. T had a DEXA scan showing her bone density at 0.74, which gives a T-score of −2.1 at the hip. Due to the compression fracture, her bone density was artificially elevated and not clinically useful. Her age of 72, height of 151 cm, weight of 70 kg and previous fragility fracture gives her FRAX-calculated risk of another fracture of 19% over the next 10 years.

**What is the epidemiology of osteoporosis?**

Estimates of osteoporosis show that Caucasian women are the highest risk group in America. Around 54% of postmenopausal women are osteopenic and 30% are...
osteoporotic, rising by age 80 to 70% osteoporotic and 27% osteopenic [4]. Worldwide, 1 in 3 women over age 50 will have an osteoporotic fragility fracture, as will 1 in 5 men. For Caucasian females, their lifetime risk of an osteoporotic fracture is around 50% [5–7].

At least 10 million Americans currently have osteoporosis, and over 33 million more are osteopenic. These numbers are expected to rise significantly over the next 30 years due to increasing life expectancy coupled with increasing numbers of those reaching at-risk ages [1].

The female-to-male ratio of fragility fractures is approximately 1.6 [8]. Women have a 16% life-time risk of vertebral fracture after age 50, while men have a 5% risk [6]. One vertebral fracture gives a woman a 25% chance of another fracture in the next 5 years. This risk can be cut in half with osteoporosis treatment [9].

Costs of fracture care for osteoporosis were around $19 billion in 2005 [10].

- **What is the clinical presentation of compression fracture?**

**Presenting Symptoms**

Many osteoporotic compression fractures are asymptomatic or minimally symptomatic, and may appear clinically as a thoracic or lumbar strain. Others will be very symptomatic and painfully disabling. Pain is the most common presenting symptom and can occur anywhere in the spine, with the lower thoracic and upper lumbar regions being most common.

In rare cases, such as those of an unstable burst fracture, patients may present with neurologic symptoms from elements of the middle and posterior spinal column impinging on spinal nerves or the spinal cord itself. These could be symptoms of weakness in the lower extremities, numbness and other paresthesias in the lower extremities, pain in the lower extremities, or loss of bowel or bladder control. The presence of any of these “red flags” should prompt an urgent neurologic investigation, including magnetic resonance imaging (MRI) of the thoracic and/or lumbar spine as indicated.

The pain of osteoporotic compression fractures is often localized to the posterior trunk in the area of the fracture. It may be rated by the patient as anything from mild to excruciating and is usually a constant pain. It is often worsened while sitting or standing, and improved while supine or prone. It usually does not radiate far unless there is neurologic involvement. It may be described many ways.

**Physical Examination Findings**

Subacute to chronic fractures may not be clinically apparent and are often discovered serendipitously. Loss of total body height, increased thoracic kyphosis, or loss of lumbar lordosis are common physical exam findings. These are the result of wedging of the vertebrae, increasing the forward-flexing angle of the spine.

On physical examination, acute osteoporotic compression fractures will often show tenderness over the affected vertebral body, but absence of this does not rule out the possibility of a fracture. This author has found that percussion over the affected vertebra can sometimes elicit pain in an acute compression fracture when palpation does not, especially in more obese individuals. This is not specific to compression fractures, however, and can be seen in other disorders such as infection, other fractures of the spinal column, or even soft-tissue injuries.

The pain of an acute compression fracture is often increased with forward flexion of the spine, either while sitting or standing, and is often improved with extension of the spine. Rotations or side bendings of the spine may or may not elicit pain.

Visual examination of the back of a patient with a suspected osteoporotic compression fracture is often normal. The skin should be normal, and there should not be any areas of visible swelling, discoloration, or warmth. The presence of these should lead the examiner to consider other etiologies for the patient’s symptoms. Depending on how severe the fracture is and/or how many vertebral bodies are fractures, increased thoracic kyphosis or loss of lumbar lordosis may or may not be seen. It should be noted that loss of lumbar lordosis is a common finding in many back injuries often due to muscle spasms or tightness.

Neurologic examination of most patients with osteoporotic compression fractures should be normal, including lower extremity strength, sensation, and reflexes. Some patients may show a degree of proximal weakness, but this will often be antalgic, ie, inhibited by pain. Again, any neurologic signs should prompt urgent work-up for spinal cord or nerve impingement.
• **What imaging is recommended?**

An x-ray is often the simplest test that will confirm the presence of an osteoporotic compression fracture. Fractures are best seen in the lateral view [11]. Measuring the relative heights of the anterior and posterior margins of the vertebral body will often confirm or deny the diagnosis. The anterior height is usually noticeably lower than the posterior height of the vertebral body. There is currently no accepted standard as to a specific ratio of anterior-to-posterior (A-P) vertebral height that is diagnostic of a wedge fracture. Also, unfortunately, a single x-ray cannot be correlated with the age of the fracture. If there are previous radiographs for comparison, this may be helpful in determining the age of a fracture. See **Figure 2** for an x-ray showing compression fracture.

Examination of the A-P height may not distinguish all compression fractures. Patients with Scheuermann...
CASE-BASED REVIEW

Disease may appear to have compression fractures at several vertebral levels. Masharawi et al concluded that the use of measurement of the anterior-to-mid height of the vertebral body, divided by the mid-to-posterior height (a “secondary derivative”) was superior to other measures for identifying osteoporotic compression fractures [12].

Additionally, it has been shown that the height of the vertebral body can change depending on how the x-ray is taken [13].

MRI is clinically useful in determining the acuteness of a fracture. See Figure 3 for an MRI scan showing compression fracture. Acute compression fractures will usually show increased signal in the endplate in the area of the fracture on T2 images. Chronic or old fractures will usually be isointense on T1 and T2 [14]. The usefulness of assessing the age of a fracture comes in the potential treatments for the fracture [15]. As discussed below, there tends to be more options for acute fractures than for chronic fractures.

Bone scintigraphy (“bone scan”) will usually show a “hot spot” in the area of the compression fracture when acute, and will often be normal when the fracture is old. This is nonspecific but may cue the clinician in to the presence of an abnormality at that level of the spine that is acute in nature [16].

CT scan is often used to evaluate the integrity of the vertebral body rather than the age of the fracture, as, like x-ray, it is difficult to tell the age of the fracture on CT scan. In cases of suspected burst fracture or other fractures involving the middle posterior elements of the spine, CT scan should usually be performed urgently.

Laboratory Testing

Laboratory testing is not usually necessary for the compression fracture but it may be beneficial for the workup of the osteoporosis. Depending on the clinical picture, the physician may wish to check blood and urine for levels of minerals including calcium, thyroid and parathyroid hormones, kidney function and other biochemical markers. The National Osteoporosis Foundation can provide more information for the interested practitioner [1].

- What is the differential diagnosis?

In addition to osteoporotic compression fracture, abnormalities of bone structure can be caused by many other means. Scheuermann disease is an important diagnosis to differentiate from compression fracture. Scheuermann disease is a congenital disorder of the vertebral endplates that often results in deformities of multiple vertebral endplates. Kyphosis of the thoracic spine is the result [17].

Scheuermann disease can be mistaken for compression fractures, and indeed, may be clinically and radiographically indistinguishable from old osteoporotic compression fractures. The presence of a wedge deformity in a young adult with normal bone density and no trauma should lead the physician to suspect Scheuermann disease in the differential diagnosis.

Malignancy is often the most worrisome diagnosis to consider in vertebral compression fracture. This pathologic fracture may not be evident on x-ray but it is often revealed on MRI. In uncertain or suspicious cases, biopsy of the vertebral body is indicated [18].

Infections of the vertebral body (osteomyelitis) are a rare cause of compression fracture. Historical information such as fever, sweating (particularly night sweating) and chills should prompt the physician to consider infection. Biopsy of the potentially infected bone may be indicated but carries risk of spread of the infection.

Nonmalignant tumors of the bone are also a rare cause of compression fracture, and are often diagnosed only by biopsy. Hemangiomas are common in the spine but do not appear to be a risk factor for compression fracture.

Figure 3. MRI scan showing compression fracture.
COMPRESSION fractures

• What is the etiology of compression fractures?

Loss of calcium mineral from the bones is the most visible manifestation of osteoporosis, but there is also loss of the microarchitecture of the bone, including collagen and other proteins. During normal aging, humans gain bone density until around the 4th decade, and then typically we see falling bone density with increasing age. This is true in both men and women. Men typically end up with higher maximal BMD than women. Hypogondanism from aging affects bone regulation, favoring osteolysis over osteoblastosis. This is more severe in older women than men due to menopause. Illnesses that affect calcium and bone metabolism may predispose patients to low BMD. Genetics likely plays a large role. Physical activity, body mass index, smoking, and alcohol use all can affect BMD as well [1].

Some medications can affect BMD, most notably corticosteroids. Long-term use of corticosteroids is the most common cause of secondary/iatrogenic osteoporosis. Other medications, including proton pump inhibitors, have been shown to reduce BMD [1].

Highly athletic females are at risk for the clinical entity known as the “female triad” — disorders of eating/energy, disorders of menstruation, and osteoporosis [19]. The 3 facets of this disorder need not all be present, but impaired diet in the face of increased energy output may result in body weight too low to support the hormonal levels necessary for menstruation, and may deprive the body of the calcium and protein needed for bone health. The low hormone levels may also affect BMD via hypogonadism, similar to that seen in elderly individuals.

This “female triad” further compounds the problem of osteoporosis, as it typically is diagnosed when females are approaching their age of maximum bone density, and they may therefore end up with lower BMD than age-matched subjects at every year for the rest of their lives. This failure to reach normal maximal bone density is of significant concern.

The exact mechanism of fracture of the spine is uncertain, as in many individuals it is often benign movements that cause them. Overloading of the superior end plate of the vertebral body is a likely common mechanism. It is likely that a combination of factors need to be present for an osteoporotic vertebral compression fracture to occur. These include low BMD, loss of bone matrix, axial loading, and often, flexion of the spine. Osteoporotic compression fractures can and often do occur spontaneously, without trauma. They can happen while the patient is standing or sitting. They may happen while the individual is flexed forward to pick something up, or with increased forward center of gravity, such as while carrying objects.

Obesity poses an interesting theoretical dichotomy for osteoporotic compression fracture. Obesity may protect an individual from osteoporosis due to increased load bearing on the bones resulting in higher metabolic osteoblastic activity relative to osteoclastic activity. The net result is a higher BMD than in other age- and sex-matched controls. However, obesity increases the axial load, and could exacerbate an anterior center of gravity when flexed forward, theoretically increasing the risk of compression in a person with low bone density.

• What are treatment options?

Initial treatment of an osteoporotic compression fracture focuses on pain control and avoiding disability. For a wedge or stable burst fracture, heat, massage, and relative rest are often beneficial. For unstable fractures, surgical intervention is often required. For stable burst fractures, nonsurgical care is usually recommended.

Extension bracing is commonly employed. This helps prevent the pain of flexion, may relieve pressure on the anterior elements and may help promote a more natural posture. There is no evidence that bracing prevents kyphotic deformity. There is the possibility that extension bracing may place increased stress on posterior spinal elements. Therefore, an examination of the risks versus the benefits of extension bracing must be done for each patient individually. Examples of extension braces include Knight-Taylor and Jewett.

Medications are commonly employed. Acetaminophen and over-the-counter nonsteroidal anti-inflammatory drugs (NSAIDs) are often used for pain control. If pain control cannot be established with OTC medications, prescription NSAIDs, tramadol, or opioids may be used. Side effects and risks of these medications are of increasing concern in the elderly.
and the medication or medications used need to be tailored to the individual.

Acetaminophen is often a first-line therapy, but it carries risk of liver damage when used in high doses, such as over 4000 mg/day, or in individuals with pre-existing liver dysfunction, such as hepatitis from infection or alcohol abuse.

NSAIDs, both OTC and prescription, may help with pain and inflammation from osteoporotic compression fracture but carry risk of gastrointestinal ulceration and bleeding, increased risk of bleeding due to effects on coagulation, elevations of blood pressure leading to increased incidence of myocardial infarction or cerebrovascular accident, and kidney damage. Many of these side effects and risks are worse in the elderly [20].

Tramadol is a partial opioid with potentially less risk of abuse than traditional opioids. It likely affects multiple receptors involved in pain. It carries risk of dizziness, sedation, and seizure disorder.

Opioids may be used for moderate to severe pain, such as that from osteoporotic compression fracture. They are highly effective in the treatment of acute pain, but carry side effects of sedation, nausea, constipation, and itching. Many of these side effects are worse with advancing age. Opioids also carry potential for abuse, tolerance, addiction and diversion. Elderly patients are typically at less risk of these issues than younger patients [21].

Calcitonin nasal spray has been advocated for the pain of an osteoporotic compression fracture [22]. Other osteoporosis medications, such as bisphosphonates, have not been shown to help in the pain control of a patient with an osteoporotic compression fracture.

Physical therapy may be prescribed to help a patient with pain control via modalities such as heat, massage, and TENS units. Literature supporting the use of these for osteoporotic compression fractures is lacking, but anecdotal evidence suggests they are common. Physical therapy may also be used to help the patient learn an exercise program, improve strength, and importantly, improve extensor muscle strength. Strengthening of the extensor muscles may help decrease pain and decrease pressure on the anterior elements of the spine, potentially reducing the chances of exacerbation of the fracture or fracture of another vertebral body. Strengthening exercises may increase bone density. Resistance against gravity, as in the case of land-based strengthening exercises, is likely of more benefit to the patient than gravity-reduced or eliminated strengthening, such as aqua-therapy.

**What are interventional pain management strategies?**

Epidural steroid injection may be tried in cases of vertebral compression fracture with radicular symptoms [23]. These may temporarily help control the pain. However, the presence of these radicular symptoms should lead the physician to investigate the fracture for middle or posterior vertebral body fracture, which should be evaluated for stability, ie, if surgical intervention is necessary. For fractures without radicular symptoms, there is insufficient research to determine if epidural steroid injection would be beneficial.

The risks of epidural steroid injection are small but well documented. Local tissue damage, such as the needle injuring nerves or blood vessels, is a risk. Infection is a rare complication of epidural injection. Spinal headaches—also known as post-dural puncture headaches—are a known complication. These are usually self-limited, although occasionally they may require further treatment [24]. Systemic side effects are possible but uncommon and may include self-limited effects such as facial flushing, or more serious effects such as alterations in blood glucose metabolism or immune function.

Vertebroplasty and kyphoplasty are 2 minimally invasive procedures that can be employed for osteoporotic compression fractures. Both involve the injection of polymethylmethacrylate, often referred to as “bone cement.”

Vertebroplasty uses a fluoroscopically-guided needle to enter the compressed vertebral body and inject this cement into the fracture. It is usually done as an outpatient procedure. This is considered mainly a pain-relieving procedure. The exact mechanism of pain relief is not known but may be related to both the fixation of the fractured elements and the heat generated from the chemicals mixed causing neurolysis of intra-vertebral nerves. Vertebroplasty attempts to inject the cement into the vertebral body “as is” — not attempting to alter the height or “wedging” of the vertebral body. Vertebroplasty has been claimed by at least 1 author to improve pulmonary function as well as pain [25].
Kyphoplasty is done in a fashion similar to vertebroplasty but also adds in inflating a bladder within the vertebral body in the area of the fracture to increase the vertebral height, then filling it with cement. Advocates of the procedure believe that restoring a more normal vertebral height may result in better functional and pain-control outcomes than vertebroplasty. Research has not so far reached this conclusion definitively when compared to vertebroplasty [26].

Both vertebroplasty and kyphoplasty have risks [27–29]. Malpositioning of the needle could result in damage to surrounding tissues, including nerves and blood vessels. There have been reported cases of cement leakage and migration from the fracture site, most worrisome when it enters the spinal canal causing damage to spinal nerves, or entering a blood vessel, resulting in embolization. There are also concerns that the spinal levels above and/or below the level treated with vertebroplasty or kyphoplasty may experience increased risk of compression fracture. It is uncertain at this time if vertebroplasty or kyphoplasty increases the risk of adjacent vertebral fracture.

Recent literature has also called into question the validity of vertebroplasty and kyphoplasty [30–32]. More recent literature does seem to support the use of these techniques as both safe and effective [33]. To date, there are no long-term studies utilizing large numbers of placebo/sham-controlled patients or sufficiently blinded studies to unequivocally draw conclusions.

Surgery is rarely indicated for osteoporotic compression fracture and is usually reserved only for cases of unstable fracture or neurologic impingement. However, surgery carries significant risk in this population, as advanced age is usually accompanied by multiple comorbidities, and the low bone density makes securing bone fragments with hardware difficult.

• What are other treatment considerations?

Management of Osteoporosis

In addition to treatment of the osteoporotic compression fracture, the clinician must look at treating the underlying osteoporosis. As above, DEXA may be employed to assess the degree of osteoporosis. In clinical practice, the presence of low BMD with vertebral fracture is often sufficient to diagnose severe osteoporosis. Laboratory investigation may be needed to assess primary and secondary causes of osteoporosis. There are currently many medications to consider in the treatment of low BMD. Recommendations range from the supplementation of calcium and vitamin D, to oral medications, which may be daily, weekly or monthly, to intramuscular or intravenous medications. If the patient with an osteoporotic compression fracture is already undergoing osteoporosis treatment at the time of the fracture, one should look at the need to change the current plan to decrease the chance of another fracture.

Physical medicine and rehabilitation intervention is an emerging therapy for osteoporosis management. Evaluation of patient function, treatment of disability and prevention of complications are the cornerstone of physiatric therapy. Additionally, the skilled physiatrist can assist with pain management and lifestyle and risk factor modification.

Medication considerations for osteoporosis management include bisphosphonates, calcitonin, estrogens, parathyroid hormone fragment and raloxifene [1]. Selection of a medication is dependent on the underlying cause of the osteoporosis and individual factors in the patient’s history.

Case Follow-up

Mrs. T discussed treatment options with the orthopedic surgeon. He noted that the fracture was a stable, wedge-type fracture and did not recommend surgery. She was referred to a physiatrist for non-operative management. Mrs. T was managed initially with low-dose hydrocodone with acetaminophen and a Jewett-style extension brace. These managed her pain, but after 2 weeks she stopped the hydrocodone due to mild sedation and constipation. She was able to use acetaminophen 650 mg 4 times daily for pain control.

Mrs. T was referred for physical therapy where she received modalities such as heat for pain control and was taught strengthening exercises for the spine, particularly focusing on extension-based exercises. She was discharged with her pain under good control and independence with a home exercise program. She stopped using the brace continually after 6 weeks and felt good without it, but still used it when she needed to stand or walk for extended periods. As her pain was gradually improving, she and her physician decided against the use of vertebroplasty or kyphoplasty. By 12 weeks post-fracture, she reported her pain was virtually gone. She continues to
do her weight-bearing exercise, including strengthening and aerobic exercise at home, as has regained her former independent lifestyle.

• What outcomes have been seen in patients with compression fracture?

Outcomes for osteoporosis, in general, are good if the condition is treated early. It can be prevented in many people with intervention, possibly including weight-bearing exercise, adequate calcium and vitamin D intake, and avoidance of certain risk factors. In those with osteoporosis, the condition may be reversible in many individuals, with treatments such as exercise, supplementary calcium and vitamin D, and/or bisphosphonates.

The outcomes for those with osteoporotic compression fractures in the spine are less certain but appear favorable with treatment. Left untreated, chronic pain and abnormal spinal alignment are likely sequelae of osteoporotic spinal compression fractures. With treatment, as outlined above, the hope is patients will experience less pain, greater function, and less risk of a repeat compression fracture.

In 2009, Kallmes et al published a study of 131 patients who underwent either vertebroplasty or a sham procedure and found no statistically significant difference in function (via Roland-Morris Disability Questionnaire) or pain (via numeric rating scale) [32]. This article has led to calls for more studies and reports of private insurance companies declaring the procedure unproven. This was not a blinded study, but blinding for this type of study would be difficult. While there is no absolute standard, the visual analog scale (VAS) is often thought to be scientifically superior to the numerical rating scale for pain rating, and may have been a better measurement tool.

Boonen et al recently published a 2-year outcomes trial with kyphoplasty showing that back pain was improved throughout the study (6, 12, and 24 months) but improvement in SF-36 was not statistically significantly different at 12 or 24 months, though it was improved at 6 months [34]. There was a control group that did not receive kyphoplasty, but the study was unblinded.

Chen et al looked at unipedicular versus bipedicular (injecting cement via one side or both of the vertebral body) kyphoplasty and found improvements compared to baseline in both groups in terms of pain by VAS and disability via Oswestry disability index, but no difference between the groups. There was no control group, but the authors concluded that the unipedicular approach is equal to the bipedicular approach for outcomes [35].

Han et al performed a meta-analysis of 8 studies comparing vertebroplasty to kyphoplasty. The outcomes were similar, but vertebroplasty showed improved pain relief within the first 7 days post-procedure, while kyphoplasty showed improvement in intermediate-term (3 months) relief [36]. The was no difference in long-term pain relief between these 2 procedures.

Yan et al recently evaluated 192 patients with vertebroplasty or kyphoplasty up to 1 year and showed improved pain scores immediately post-procedure and at 1 year [37]. There was no control group. It does not appear to be a randomized study.

Folman and Shabat found that both kyphoplasty and vertebroplasty had identical pain relief outcomes, but kyphoplasty improved vertebral height [38]. As kyphoplasty is intended to improve vertebral height, this outcome is expected, and has been found in numerous studies.

Tanigawa et al reviewed 194 patients who underwent vertebroplasty [39]. They found pain relief greatly improved by vertebroplasty, and this pain relief improved and was maintained for up to 7 years.

At this time, there have been no large-scale, randomized, blinded, sham- or placebo-controlled studies comparing vertebroplasty and kyphoplasty. One cannot therefore yet draw the conclusion that for the population at large, there is clear evidence that these procedures result in long-term positive outcomes compared with controls. There is significant evidence that these procedures result in short- to intermediate-term pain relief compared with baseline.

It is the author’s opinion that vertebroplasty is equivalent to kyphoplasty in terms of pain relief and functional outcome, and although kyphoplasty improves vertebral height, that improvement does not appear to have significance in terms of outcomes. It is further this author's opinion that the short-term improvements in pain relief with these procedures compared with baseline is sufficient to justify the use of these procedures in patients whose pain cannot be effectively controlled by other means. The element of
human suffering is difficult to quantify in studies, and the practitioner should keep the this in mind when selecting treatments for osteoporotic vertebral compression fractures.

**SUMMARY**

Osteoporotic compression fractures of the spine are becoming increasingly common as our population ages. Some or possibly many of these fractures can be avoided if patients are assessed and treated for osteoporosis in the early stages of the disease. Assessment of bone density with DEXA is an easy, noninvasive method of assessing osteoporotic fracture risk, and the FRAX tool may augment this.

For patients who have osteoporotic vertebral compression fractures, identification of the fracture and assessment of the type of fracture are essential to the proper treatment. Very few osteoporotic vertebral compression fractures will require surgery. Most can be treated nonoperatively. Treatment options include medications, bracing, physical therapy, and interventional pain management. Treatment of the underlying osteoporosis is also essential for successful long-term patient function.

**REFERENCES**

3. WHO Fracture Risk Assessment Tool. www.shef.ac.uk/FRAX/index.jsp


