



Standard of Care: Vertebral Augmentation

ICD 9 Codes: Osteoporosis 733. 0, Vertebral Fracture closed 805.8, Pathological fracture of Vertebrae 733.13

Vertebral augmentation, known as vertebroplasty and kyphoplasty, is a minimally invasive procedure that is used to treat vertebral fractures. Vertebral fractures are the most common skeletal injury associated with osteoporosis, and it is estimated that more than 750,000 occur annually in the United States.¹ Up to one quarter of people over 50 years of age will have at least one vertebral fracture in their life time secondary to osteoporosis.² According to the World Health Organization (WHO), the operational definition of osteoporosis is a bone density measure >2.5 standard deviations (SD) below the mean of young healthy adults of similar race and gender.³ Primary osteoporosis is related to the changes in postmenopausal women secondary to reduction of estrogen levels and related to age-related loss of bone mass. Secondary osteoporosis is the loss of bone caused by an agent or disease process.^{1,4} (See Osteoporosis SOC)

The severity of vertebral fractures can be assessed by the Genat semiquantitative method. Commonly used by radiologists, this scale assesses the severity of the fracture visually and has been shown to be reliable.⁵

Genat Semiquantitative Grading System for Vertebral Deformity⁵

Grade 0- normal vertebral height

Grade 1- minimal fracture- 20-25% height decrease

Grade 2- moderate fracture- 25-40% height decrease

Grade 3-severe- >40% height decrease

Standard methods of diagnosing vertebral fractures are imaging, including the following: CT scan, MRI, and radiography. Radiography includes AP (anterior posterior) view and lateral view, with the lateral view being the gold standard. Most vertebral fractures occur at the mid thoracic spine and at the thoracolumbar junction.⁵

Vertebral fractures often result in deformities such as increased thoracic kyphosis/Dowager's hump and a protuberant abdomen.⁶ These deformities can result in significant pain that often leads to decreased mobility, loss of independence, and subsequent loss of bone density associated with inactivity. Vertebral fractures can also have negative effects on the respiratory and digestive systems due to resultant postural deformity.¹

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There is a significant increased mortality rate in patients with vertebral fractures treated conservatively compared to age-matched controls in the literature.⁴ The 5-year survival rate for patients with compression fractures is 61%, as compared with 76% with age-matched peers.⁷

Until recently, these fractures have primarily been treated conservatively for pain management. Traditional treatment includes bed rest, analgesics and bracing.⁴ However, during the past twenty years, two new radiologic interventional procedures have been developed to manage these fractures: kyphoplasty and vertebroplasty.⁴ Kyphoplasty and vertebroplasty are surgical techniques to stabilize vertebral fractures by injection of bone cement called polymethylmethacrylate (PMMA) by needle into to the fracture site.⁸ Kyphoplasty involves insertion of a balloon tamp to increase the vertebral height prior to PMMA injection and the vertebroplasty does not involve the use of the balloon tamp. The surgical procedure was first seen in 1984. Vertebroplasty was successfully performed in France for the treatment of a cervical vertebral hemangioma. Since then, the application of kyphoplasty and vertebroplasty have been expanded to include the treatment of the pain caused by vertebral compression fractures.⁹ Kyphoplasty and vertebroplasty currently have approval from the US Food and Drug Administration (FDA) for intraosseous injection of acrylic cement under local anesthesia and fluoroscopic guidance to control the pain of vertebral fractures associated with osteoporosis, tumors, and trauma.⁹

Kyphoplasty and vertebroplasty are performed by interventional radiologists and neurointerventional radiologists. The primary indication for this procedure is to manage the pain associated with vertebral compression fractures.¹⁰ Considered minimally invasive procedures, vertebroplasty and kyphoplasty are performed under fluoroscopy under local or general anesthesia.⁴ Both utilize the injection of PMMA into the vertebral body, which splints the fracture internally. The difference between the two procedures is the use of the balloon tamp. Kyphoplasty involves the insertion of a balloon tamp into the vertebral body prior to cement injection, and vertebroplasty does not. In kyphoplasty, the balloon is expanded within the compressed vertebral fracture in an attempt to increase vertebral body height and correct the kyphotic deformity. Thickened PMMA is injected into the space left behind after the balloon is withdrawn.¹¹ Vertebroplasty involves injection of less viscous PMMA into the vertebral body without the use of a balloon tamp. Vertebroplasty is done primarily on an outpatient basis where as kyphoplasty may require hospital admission.¹¹

Proposed mechanisms of pain relief with vertebral augmentation are from stabilization of the fracture and local chemical effects of the cement on the nerve endings at the fracture site.⁴ The results in current literature vary. In one study, Majd et al had 254 patients that underwent kyphoplasty procedure of 1-5 vertebral levels. They noted immediate pain relief in 89% of the patients by the first follow up visit.¹² In another study by Evans et al, 49% of 245 patients interviewed reported immediate pain relief after a vertebroplasty procedure. More recently, Buchebinder et al in a randomized trial proposed no benefit of vertebroplasty as compared to a conservative control group in 78 participants at one, three and 6 months.⁶

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Not all vertebral fractures can be treated by vertebral augmentation. There are absolute contraindications for surgical vertebral augmentation which include the presence of neurologic signs (may require decompressive procedure), osteomyelitis, and coagulopathy.⁴ And as with any surgical procedure there are potential risks including infection, migration of cement, worsening of pain or new neurologic symptoms.⁴

Although there is no literature regarding specific physical therapy (PT) intervention for this procedure, there is an important role for physical therapy with this patient population. The patient may be deconditioned as a result of bed rest and decreased activity. This can lead to further bone density loss, loss of muscle mass, decreased balance and decreased functional mobility. Given the loss of bone density, a fall could have devastating consequences. Therefore, maximizing a patient's balance and activity level is paramount with this patient population. In addition, associated muscle imbalances such as decreased length of the gastroc-soleus complex and weakness in large lower extremity musculature and postural muscles may contribute to an increased risk of falls.¹³

Considering the findings on evaluation, the program may include balance and gait training, extensor muscle strengthening, and importantly, education about posture, positioning, bending/lifting techniques in order to minimize incidence of new fractures and/or worsening of known vertebral fractures.¹³

Indications for Treatment:

Patients may present to physical therapy preoperatively with acute or chronic compression fracture(s) or postoperatively after undergoing vertebroplasty or kyphoplasty.

Contraindications / Precautions for Treatment:

Care should be taken as this patient population has decreased bone density (See Osteoporosis SOC). Joint mobilization, flexion activity and heavy resistance should be limited due to anterior compressive forces on the vertebrae.¹⁴ Consult with the referring physician to discuss patient's postoperative status.

A recent study by Yi-An et al found a 38% incidence of subsequent vertebral fracture after vertebroplasty, and in their study they referred patients to physical therapy post-vertebroplasty if the patients had low activity levels or poor body mechanics. In the same study the volume of cement injected directly correlated with greater correction of the deformity, but also with a higher risk of adjacent fracture.¹⁵

Some complications of vertebroplasty to watch for are¹⁵...

- Nerve root damage
- Cord compression
- Rib fracture
- Infection

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- Emboli
- Adjacent level fractures

Evaluation:

Medical History: Review patient's medical history questionnaire and longitudinal medical record (LMR). Review pertinent diagnostic imaging, lab tests, and additional medical work up. Note any history of trauma/falls, history of spinal fracture(s), previous surgeries, and comorbidities including endocrine, nutritional status, rheumatologic or hepatic disorders.

Imaging: Radiography including AP and lateral views, CT scan, bone densitometry, and MRI of spine.

History of Present Illness: Patients may be referred to physical therapy by their physician, pre or postoperatively if they believe the patient will benefit from PT.

Gather information including chief complaint, duration of symptoms, and change in symptoms pre to postoperatively, date of surgery, prior level of function and activity, previous physical therapy, history of falls and patient goals.

Social History: This includes the patient's home environment, social support, and outside services. Discuss management of activities of daily living, including shower/bath arrangement, stairs/handrails. Discuss strategies to minimize fall risk including removing throw rugs and keeping walk ways clear of obstacles. Confirm that they maintain adequate lighting in the home at night.

Medications: Review of medication should consider possible fall risks associated with medication. For example, narcotics and benzodiazapenes are medications that can result in orthostatic hypotension. Pain medications are generally tapered down after the procedure and generally are not required after these procedures.

Examination (Physical / Cognitive / applicable tests and measures / other)

This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.

Pain: measured on the VAS scale; activities that increase symptoms, decrease symptoms, location, quality, and frequency of symptoms

Posture/alignment: Patient may present with increased thoracic kyphosis. Note abnormal postures including kyphosis, scoliosis, forward head, asymmetric scapular position, dowagers hump, etc.

Palpation: Note muscular density (periscapular and thoracolumbar extensors) and scar density and mobility.

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Sensation: Consider patient's pre and post operative report of sensation and /or sensation changes as there can be neural compromise from vertebral fractures.

ROM: ROM of the upper and lower extremities and the spine. Evaluation of spinal ROM should also be assessed with consideration of physician's postoperative orders.

Muscle Length: Depending on the area or areas of focus, consider the following: Assess musculature influencing balance and posture including hip flexors, hamstrings and gastrocnemius, pectoral area, serratus anterior, rhomboids, middle trapezius; cervical flexors and extensors.

Strength: Manual muscle testing of UEs and LEs, and core strength. Precaution is taken when applying resistance with individuals with severe osteoporosis and may not be indicated for individuals who have recently undergone surgery.

Balance: Consider patient presentation and patient needs when selecting balance tests. Balance tests that could be utilized include: Berg balance scale, Rhomberg, Single Leg Stance, Functional Reach, Timed Up and Go, sidestepping, braiding, tandem ambulation, posterior ambulation, etc.
(See Balance SOC for specific details)

Functional mobility: Assess bed mobility, transfers, ambulation and stair climbing. Consider appropriate assistive device.

Gait: Assess for common gait deviations- antalgic, trendelenberg, and myelopathic gait.

Assessment:

(Establish Diagnosis and Need for Skilled Services)

Problem List (Identify Impairment(s) and/ or dysfunction(s))

- Pain
- Impaired posture
- Impaired ROM
- Impaired strength
- Impaired balance
- Impaired functional mobility
- Impaired knowledge

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Prognosis: This will vary depending on the patient. Factors to consider include history of previous fractures, previous surgeries, history of falls, social support, and comorbidities. Also, this group often has comorbidities including severe degenerative joint disease and spinal stenosis, which may affect the outcome.¹³

Goals (Measurable parameters and specific timelines to be included on evaluation)

1. Decreased pain or independent self-pain management
2. Increased ROM and improved self correction of posture
3. Increased strength
4. Improved balance
5. Improved gait
6. Maximized functional mobility
7. Independence with a home exercise program
8. Demonstrates or verbalizes knowledge of prevention of future vertebral compression fractures

Age Specific Considerations- Bone mass naturally decreases with age, consider potential new compression fractures

Treatment Planning / Interventions

Established Pathway	<input type="checkbox"/> Yes, see attached.	<input checked="" type="checkbox"/> No
Established Protocol	<input type="checkbox"/> Yes, see attached.	<input checked="" type="checkbox"/> No

Interventions most commonly used for this case type/diagnosis.

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

- **Posture training:** Observe patient's alignment of the head, neck, shoulders, spine, LEs. Observe posture in sitting, standing, and during gait. Make appropriate corrections and recommendations for optimal posture and comfort in sitting, standing, laying down.
- **Stretching:** Static stretching of identified muscular imbalances, which may include suboccipitals, pectoralis major and minor, ilopsoas, rectus femoris, hamstrings, and gastro/soleus.

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- **Strengthening:** Target specific strengthening based on examination and postoperative orders. Consider lumbar stabilization, weightbearing activities, and use of free weights.

Lower Extremities: These exercises may include quad sets, gluteal sets, standing hip AROM abduction, extension, marching, standing heel raises, standing toe raises, wall slides, straight leg raises, side lying hip abduction/external rotation, side lying hip abduction, standing resisted abduction with Theraband, standing resisted hip extension with Theraband.

Upper Extremities: These exercises may include bilateral resisted shoulder external rotation with Theraband, bilateral resisted shoulder extension with band, bilateral resisted shoulder rows.

Stabilization: Sahrman progression of lumbar stabilization includes the following- transverse abdominis setting, transverse abdominis setting with hook-lying marching, transverse abdominis setting with hook-lying marching with heel slides, transverse abdominis setting with alternate shoulder flexion, transverse abdominis setting with alternate straight leg raise.¹⁶

- **Balance training:** Based on exam findings consider balance training. Examples of balance training exercises are unilateral standing, weight-shifting, sidestepping, braiding, and tandem stance. Incorporate balance training on uneven surfaces as appropriate. This may include using a balance disc or foam.
- **Mobility training:** Address transitional movements including supine to sit and sit to stand to minimize spinal flexion motion. Include training with use of log roll technique for supine to sit to minimize flexion as well as rotation along the spine. Consider gait training with an assistive device when appropriate.
- **Aerobic exercise:** Weightbearing activity including walking outdoors or on a treadmill is the preferred mode of aerobic exercise if the patient is able to tolerate. Assess appropriate mode and frequency.
- **Modalities:** As indicated for pain relief
- **Patient Education:** Including body mechanics, joint protection, postural awareness and re-education, HEP, mobility and safety in home setting. Patient's can find additional resources through the National Osteoporosis Foundation (www.nof.org)

Frequency & Duration:

1-2X/week for 4-8 weeks. This could vary considerably for each patient.

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Recommendations and referrals to other providers.

- Pain management
- Endocrinology
- Rheumatology
- Primary care
- Neurology

Re-evaluation

- Standard Time Frame- 30 days or less as appropriate.
- Assess and document significant change in signs and symptoms, fall, change in medication, successful completion of short-term goals.

Discharge Planning

Commonly expected outcomes at discharge: Independent with HEP, independence with community ambulation, Independent with ADLs, demonstrates good body mechanics, demonstration of good understanding of patient education regarding joint protection techniques.

Patient's discharge instructions: Patient's discharge instructions include a HEP, body mechanics, and home safety modifications, if applicable.

Authors:

Ethan Jerome
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Update:

Kenneth Shannon /Debbie Canoa
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Reviewed by:

Kenneth Shannon
Joel Fallano

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