

Interventional Radiology GRAND ROUNDS

Vertebroplasty: A Minimally Invasive Treatment for Vertebral Compression Fractures and Osseous Lesions

Approximately 700,000 compression fractures of the spine related to osteoporosis and other conditions occur each year in the United States, often leading to chronic pain and decreased function and mobility, loss of employment, insomnia and depression. Spinal deformities resulting from loss of vertebral body height (kyphoscoliosis) may lead to

functional disability, and spinal cord compression may ultimately result from untreated fractures, leading to motor dysfunction, incontinence and other neurological deficits. Surgical intervention rarely is an option because of the technical difficulties associated with hardware fixation in osteoporotic bone and the risks associated with comorbid conditions that frequently are present in this primarily elderly patient population. Conventional treatments such as bed rest, orthotics, physical therapy, NSAIDs and narcotics often are ineffective or have unacceptable adverse effects.

Case History

An elderly patient with relatively mild osteoporosis and an upper lumbar vertebral fracture consulted the interventional radiologist group at Northwestern Memorial Hospital, Chicago, because of severe, intractable pain that had lasted for several months (longer than typical for treated patients at the institution). She had undergone prior conservative treatment, including external bracing which resulted in intolerable discomfort. Local tenderness was elicited over the affected vertebra by physical examination performed with fluoroscopic guidance, and a decision to treat was made. Initial unilateral injection of cement resulted in incomplete pain relief; complete pain relief was achieved after cement was injected into the contralateral side of the vertebra.



Figure 1



Figure 2



Figure 3

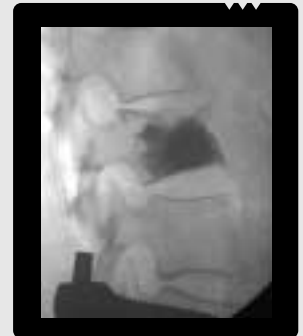
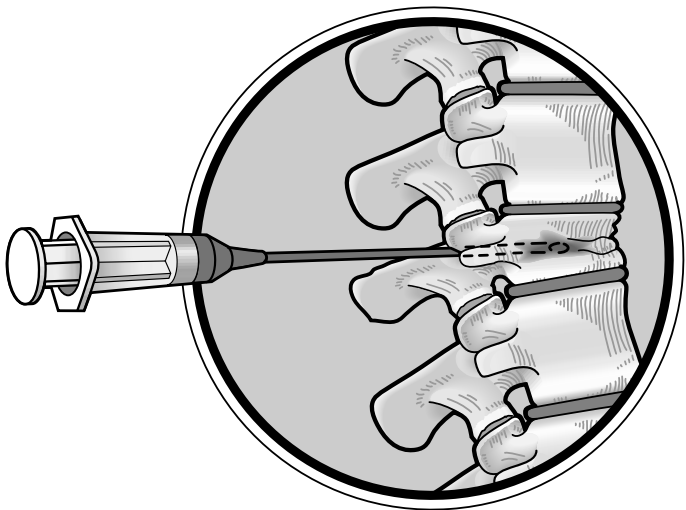


Figure 4

AP and lateral radiographs taken at the time of the procedure show mild to moderate compression of an upper lumbar vertebra, with the fracture primarily affecting the superior endplate (**Fig. 1 & 2**). The needle used for vertebroplasty is in place, extending through the pedicle. Cement initially filled only the ipsilateral half of the vertebra, and completion of the procedure required placement of a second needle (not shown). Two follow-up radiographs after the final (second) procedure show excellent deposition of radio-opaque cement in both halves of the vertebral body (**Fig. 3 & 4**). The patient had complete relief of pain following the procedure.

Percutaneous vertebroplasty is an interventional radiology technique introduced in France in the 1980s and perfected in the United States since 1995. It has been used successfully to relieve the symptoms of osteoporotic vertebral compression fractures, as well as spinal metastases and other osseous lesions, and to control perioperative blood loss in the treatment of spinal hemangiomas. In the technique, bone cement is injected under fluoroscopic or CT guidance into the vertebral body to stabilize it and relieve pain. The cement also makes the vertebral body stronger, and can prevent further collapse. In most cases, however, vertebroplasty does not restore the vertebral body to normal height.



Prevalence and Risk Factors

Osteoporosis affects 44 million Americans, or 55 percent of the population over age 50; of these, 80 percent are women, according to the National Osteoporosis Foundation. Younger people also suffer these fractures, particularly those whose bones have become fragile due to the long-term use of steroids or other drugs to treat a variety of diseases such as lupus, asthma and rheumatoid arthritis.

Most vertebral fractures, however, result from osteoporosis, which accounts for 1.5 million fractures annually, approximately half of which are fractures of the vertebrae.¹ The condition takes an

enormous personal and economic toll, accounting for more than \$13.8 billion in direct medical expenses each year.² About one-third of vertebral fractures will be diagnosed clinically, 8 percent will require hospitalization, and about 2 percent will require long-term nursing care.³

Risk factors for osteoporosis include:

- Caucasian or Asian race
- Thin, petite body type and/or excessive dieting
- A family history of osteoporosis
- Early menopause
- Lactose intolerance
- Smoking, or excessive use of caffeine or alcohol
- Estrogen deficiency
- Sedentary lifestyle

Diagnosis

In patients with severe pain unresponsive to conservative therapy, conventional radiographs, magnetic resonance imaging, computed tomography and/or bone scans are performed to locate the fracture or fractures that are causing the pain, determine the degree of vertebral compression, and rule out other causes of pain that are contraindications for vertebroplasty.

The Procedure

When the area is located and confirmed by correlating clinical history and physical examination with imaging findings, a neuroradiologist or interventional radiologist passes a hollow needle into the vertebral body. Polymethylmethacrylate (PMMA) cement mixed with barium powder, which makes the cement visible on X-ray, is injected under imaging guidance. Antibiotics often are added to the mixture for prophylaxis against infection. The cement hardens rapidly, usually within 15 minutes,

and stabilizes the weakened bone. The procedure usually is performed in an interventional radiology suite with single or biplane C-arm fluoroscopy. In most cases, the patient is placed prone on the X-ray table and sedated with a short-acting narcotic and benzodiazopine. Occasionally, general anesthesia may be necessary. Alternatively, CT scans may be employed to guide the cement injection. Treatment of fractures at multiple levels may be performed at one time, or several treatment sessions may be required. A variety of injection systems are available.

The procedure typically takes one to two hours and the patient remains at bed rest for one to several hours. The procedure can be performed on an outpatient basis, but overnight hospitalization may be required, especially in elderly patients with other medical conditions.

Results

Significant pain relief has been reported in from 75 percent to 90 percent of patients with benign bone fractures⁴ and in 59 percent to 86 percent of patients with vertebral compression fractures due to malignant disease.⁵ In one recent prospective study with long-term follow-up using Musculoskeletal Outcomes Data Evaluation and Management System (MODEMS) questionnaires designed specifically to evaluate the efficacy of musculoskeletal interventions such as percutaneous vertebroplasty, 29 of 30 patients reported pain relief in the hours immediately following the procedure, and 96 percent of patients available for follow up (n=23) remained satisfied with the outcome 15-18 months following the procedure.⁴

Indications

People who have suffered recent compression fractures with moderate to severe back pain are the best candidates for vertebroplasty. Older fractures may be treated successfully, but the procedure is most efficacious if it is performed within a few weeks to several months after the fracture occurs. The procedure cannot be used to treat chronic back pain due to other causes, such as arthritis and herniated disks.

Contraindications

Patients may be unsuitable candidates for vertebroplasty if they have:

- A vertebra that has collapsed to less than one-third its original height
- Coagulation disorders
- Medical conditions that make them unable to lie prone for the procedure
- Uncertain causes of pain

Procedure-related complications

Vertebroplasty-related complications occur in approximately 1 percent to 3 percent of patients treated for osteoporotic compression fractures⁴ and up to 10 percent of patients treated for metastatic disease,⁵ the majority of which are not clinically significant. Complications may include leakage of PMMA during injection, injury to adjacent nerves, pulmonary emboli and, rarely, paralysis. Serious complications are rare and usually are the result of improper needle placement, poorly monitored cement application or improper patient selection.⁶ For this reason, performance of the technique by experienced practitioners with high-quality image guidance equipment is essential.

References

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