

PERCUTANEOUS VERTEBROPLASTY for the Treatment of Spinal Compression Fractures and Spinal Tumor

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INTRODUCTION

Percutaneous vertebroplasty (PV) is a new, highly effective and minimally invasive interventional therapeutic alternative for the treatment of pain, progressive deformity and complications associated with spinal compression fractures. This outpatient technique is also used to treat fractures, impending fracture, or pain associated with benign and malignant spinal tumors.

COMPRESSION FRACTURE

Spinal compression fractures are caused when axial loading forces exceed the fracture threshold of the vertebral body. In patients with normal bone density, such fractures can be caused by severe trauma such as falls and auto accidents. When compression fractures occur in young individuals or in individuals with normal bone mineral density, the deformity does not usually progress over time and healing usually occurs rapidly. Recovery can still take many weeks or months before associated pain and disability disappear. During this time, back pain can be incapacitating and the disability accompanying these fractures can be severe and costly.

OSTEOPOROSIS

Osteoporotic compression fractures are usually associated with the elderly or patients dependant upon chronic steroid therapy. It is estimated that 35 million elderly Americans suffer from osteoporosis. Annually, more than 500,000 new spinal fractures occur in this group of patients. An additional 240,000 hip fractures occur every year resulting in 52,000 deaths from long-term complications and sequelae. The severity of trauma required to produce compression fractures in osteoporotic patients is minimal. The fracture threshold in the spine can easily be exceeded by twisting, bending, sneezing, coughing, or a fall. Some patients who suffer fracture are not aware of any associated trauma. It is not uncommon to have several vertebral fractures occur at the same time or within several weeks or months of the first fracture. Since osteoporotic bone is extremely weak and bone healing is very slow, these fractures often progress over time with increasing deformity/collapse and prolonged pain. Many of these fractures initially show only minimal loss of vertebral body height and progress over time to much more severe fractures. This can lead to increasing deformity which may result in spinal stenosis and with associated compression of the spinal cord or nerve roots. More severe fractures in the thoracic area are also associated with rib impingement and chest wall pain.

Many of these elderly patients are self-sufficient prior to their injury but are unable to maintain their previous level of activity following the fracture due to severe pain. Some of these patients require hospitalization or nursing home placement, and 20% of hip fracture patients require long-term nursing care. Being at risk for these injuries can provoke anxiety in elderly patients who are often fearful of living their final years in a convalescent care facility. Pain and suffering associated with these injuries can lead to permanent loss of freedom and independence.

Osteoporotic Compression Fracture Complications

Complications associated with osteoporotic progression fractures in the elderly include: restrictive mobility, deformity/loss of height, bowel obstruction, depression, loss of lifestyle/self sufficiency, pneumonia and deep vein thrombosis/pulmonary embolus. Some patients that are not hospitalized may require home nursing care. The financial costs associated with osteoporotic spinal compression fractures are enormous. Even the best treatments for osteoporosis are limited and may require years to substantially change bone strength and reduce risk.

Conventional Treatment

Conventional treatment is limited to restricting activities, pain medication, and a brace. Pain is often very severe and narcotics are frequently prescribed. This form of treatment is not particularly effective and often dissatisfying for patients. It also places the patient at increased risk for complications such as bowel obstruction, pneumonia, deep vein thrombosis, pulmonary embolus and worsening respiratory insufficiency.

Surgical Treatment

Orthopedic or neurosurgical intervention is not generally considered for stabilization in osteoporotic patients since the necessary surgical hardware can break loose and require removal. Decompressive laminectomy is sometimes necessary when there is posterior bone protrusion into the spinal canal causing compression of the spinal cord or nerve roots. Until recently, the only therapy available to these patients was designed to minimize pain through the use of narcotics and a brace.

BENIGN AND MALIGNANT SPINAL TUMORS

Benign and malignant tumors are also associated with debilitating back pain and disability. These tumors are a significant source of potential instability and fracture. Benign tumors such as hemangiomas are infrequently associated with spinal fractures. Even when no fracture is present, hemangiomas can produce localized back pain that can be relieved by PV.

Primary and metastatic malignant tumors of the spine frequently produce severe back pain and can produce marked bone destruction resulting in fracture. Radiation therapy is usually effective in controlling pain but relief may be delayed 10-14 days following treatment, and the bone strength may be further compromised by the radiation treatments. In contrast, PV provides pain relief within 24 hours and prevents fracture or continued compression of the bone.

Osteolytic metastasis, myeloma, and painful or aggressive hemangiomas are sometimes considered for vertebroplasty, even before a fracture is present. This is due to the fact that such tumors destroy large volumes of bone that can lead to catastrophic fracture and subsequent severe pain and neurological deficit. In such cases, PV is not usually offered until appropriate oncological treatment is completed.

FRACTURE DIAGNOSIS AND WORKUP

Patients presenting with new onset of severe back pain from spinal compression fracture are initially examined with plain X-rays. Many of these patients have suffered previous compression fractures and it is not always clear which fracture is causing the symptoms. When old films are available for comparison, diagnosis of the new fracture may be somewhat easier. However, plain films aren't always sufficient for the diagnosis of acute fracture and sometimes miss a fracture in the earliest stages. When there is a high level of suspicion, Magnetic Resonance Imaging (MRI) or a Nuclear Medicine bone scan may be needed.

MRI is very sensitive for early fracture detection and in most cases is superior to bone scan. In some patients, MRI proves that the compression fracture seen on plain x-ray is, in fact, old and that the new fracture is at a different level. Such fractures in the earliest stages may be too subtle to detect with conventional X-rays. MRI may even reveal a second or third fracture when only one level was originally suspected on X-ray examination. When the level having positive MRI findings is treated with PV, the patient's pain is almost always eliminated. PV is highly effective and very well suited for treating acute or subacute fractures, but has somewhat limited value for chronic fractures.

Very limited MRI studies can be used for most patients including T1 and STIR sagittal images of the thoracic and lumbar spine. This abbreviated study takes about 15 minutes and costs about the same as a bone scan. The T1 scan shows replacement of high signal fatty marrow with low signal marrow edema in acute and subacute fracture that allows the radiologist to clearly differentiate new or subacute fractures from old fractures. This examination gives good spatial resolution, which allows the radiologist to evaluate potential compromise of the spinal canal and neural structures, and to assess the size of the pedicle through which the PV needle will be placed. Additional sequences are sometimes required if there are any areas suspicious for neoplastic disease.

HISTORY OF PERCUTANEOUS VERTEBROPLASTY

PV was originally developed in France in 1984 and was used to treat destructive spinal tumors. It was discovered that vertebroplasty was also extremely effective in stabilizing spinal fractures and eliminating associated pain. PV has been used extensively in Europe since 1987 and was introduced to the United States in 1994.

TECHNIQUE OVERVIEW AND EXPECTED RESULTS

This technique involves placing liquid acrylic, plastic "cement" into the trabecular space of the fractured vertebral body. The cement quickly hardens and produces an internal, rigid cast that prevents continued compression and motion of the fracture. The substance used is Polymethylmethacrylate (PMMA.) This is the same conventional "surgical cement" which has been

typically used in orthopedic procedures for bonding metallic joint prostheses to bone. It is also used in neurosurgery for cranioplasty.

The vast majority of patients experience complete pain relief or marked improvement within 24 hours of the procedure. Fractures treated with PV do not continue to collapse and vertebral height is maintained at the pre-treatment level. After the trabecular space of the vertebral body is filled and the cement has cured, experimental studies have shown that the vertebral body is 4-5 times stronger than a normal vertebral body. It is quite rare for vertebral bodies treated with PV to re-fracture in the future. Areas of the vertebral body that are not well filled with PMMA may re-fracture but this is also very rare.

MY EXPERIENCE AND RESULTS

Currently I have treated approximately 220 patients and injected 270 vertebral levels. The majority of my patients have fractures related to osteoporosis. Most of my patients are on Medicare and between the ages of 70 and 90 years. My youngest patient was 30 years and oldest was 101 years. Patients suffering from osteoporosis related to steroid therapy are also well represented. I have successfully treated 5 patients with spinal tumors (lung cancer, breast cancer, hemangioma and lymphoma). I normally treat one or two levels during the procedure but have treated four levels during a single procedure. I have treated up to seven levels in several patients.

Percutaneous vertebroplasty is extremely effective. 93 percent of my patients have had marked or complete pain relief. I have had at least two dozen patients complain of recurrent or severe new pain within several days to over a year following vertebroplasty that were diagnosed with new compression fractures as the cause for the new pain in almost all cases. They were re-evaluated and vertebroplasty was performed at the new levels of injury resulting in resolution of their "new" pain. Currently, I have had three patients present with a recurrent fracture at a treated level. A new fracture has only occurred in treated levels when there was suboptimal filling at the initial procedure. Two of these three patients were retreated and the pain was relieved. Almost all my cases are performed on an outpatient basis with the patients discharged about four hours following the procedure.

CONCLUSION

Percutaneous vertebroplasty is a minimally invasive outpatient therapy that is highly effective in treating painful traumatic or osteoporotic spinal compression fractures, osteolytic metastasis, myeloma, and painful or aggressive hemangiomas. This technique has a very low incidence of procedural complications and is 90-95% effective in achieving marked or complete pain relief. PV also results in a marked increase in bone strength (4-5 times stronger than normal vertebral body) and prevents progression of compression deformity and associated risk of neural injury or recurring symptoms.

To read more about Percutaneous Vertebroplasty and osteoporosis, try the following links.

For vertebroplasty:

<http://my.Webmd.com/content/article/1728.56031>

<http://my.Webmd.com/content/article/2793.125>

For osteoporosis:

http://my.Webmd.com/content/dmk/dmk_article_40065

http://my.Webmd.com/content/dmk/dmk_article_4961641