



Percutaneous vertebroplasty

FRED JOSHUA MB BS
ALLAN STURGESS PhD, FRACP, FRCPA

Percutaneous vertebroplasty is a recently introduced technique to treat pain from osteoporotic vertebral fractures. In their review of this technique, Dr Joshua and Associate Professor Sturgess stress the importance of patient selection and operator experience.

Vertebral compression fracture is a common manifestation of osteoporosis, leading to significant back pain and disability. About 16% of postmenopausal women will have such a fracture.¹ Until recently, treatment has comprised bed rest, analgesics, bracing and rehabilitation.^{2,3} Now, the use of percutaneous vertebroplasty in osteoporotic vertebral compression fractures is becoming increasingly important. The procedure is available in most capital cities and usually provided by interventional radiologists with experience in neurospinal interventions.

Percutaneous vertebroplasty involves the injection of polymethylmethacrylate (a bone cement) into a vertebral body. It was pioneered in France in the 1980s for the treatment of vertebral angioma.⁴

Dr Joshua is Rheumatology Research Fellow, St George Hospital; Associate Professor Sturgess is Senior Staff Specialist, St George Hospital, Kogarah, Sydney, NSW. Series Editor: Dr Paddy Hanrahan, BSc, MB BS, FRACP, Honorary Secretary, Australian Rheumatology Association.

Subsequently, it was shown to be useful also in the treatment of other vertebral malignant tumours.⁵

The aims of treatment with percutaneous vertebroplasty for osteoporotic compression fractures have been resolution in pain, improved mobility and bone strengthening.^{1,3}

What is the procedure?

The procedure involves passing a fluoroscopic-guided needle through the pedicle of the vertebral arch into the fractured vertebra under local anaesthesia (Figure). A transpedicular approach is usually used; a posterolateral route can be used, but this is thought to be less safe.³

The 2.5 to 5 mL of polymethylmethacrylate is injected in a viscous form until it disperses through the vertebra. If the cement does not flow through all of the vertebra, the injection can be repeated via the contralateral transpedicular route. The procedure is stopped immediately if cement is seen to leak into the spinal canal, neural foramen or paraspinal veins.¹

Patients are observed overnight after the procedure.

What are the results?

The results of percutaneous vertebroplasty have been very impressive. Cortet and colleagues showed 14 of 16 (88%) patients had at least a 25% improvement in pain following the procedure.¹ Jensen and colleagues reported similar results, with improvements seen in 26 of 29 (90%) patients with back pain refractory to analgesic therapy.⁶ Cyteval and colleagues showed complete pain relief in 15 of 20 (75%) patients,⁷ and, in Australia, Diamond and Clark showed improvement in four patients treated with this technique.³

The results for pain relief all occurred very quickly, within days, and, significantly, have been shown to persist in the longer term.⁸ The reduction in pain is an important result as it improves mobility and thus limits the risk of protracted

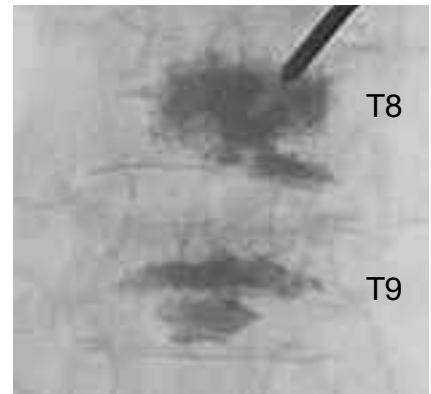


Figure. Injection of polymethylmethacrylate into the fractured T8 and T9 vertebrae of a postmenopausal woman. The needle is passed through the pedicle of the vertebral arch under fluoroscopic guidance.

Percutaneous vertebroplasty: patient selection criteria

- Ongoing pain post-crush fracture due to osteoporosis
- No neurological symptoms
- No coagulation disorders

immobilisation. It must be noted that the trials referred to are open prospective studies and as such do not have controls.

The mechanism of pain relief induced by percutaneous vertebroplasty is unclear. Theories include:

- stabilisation of microfractures and the vertebral endplate by the cement
- decreases in mechanical stress
- destruction of nerve endings by the exothermic reaction induced by the polymethylmethacrylate.^{1,3,9}

The fractured vertebrae treated with percutaneous vertebroplasty have been shown to be stronger after the procedure. This has been shown in a comparison of cemented vertebral bodies from female cadavers with noncemented vertebral bodies for strength and stiffness.¹⁰ The same result was seen in a similar study measuring the load required to

compress cemented and noncemented cadaveric vertebral bodies.¹¹ It has been suggested also by the reduced risk of fractures seen in long term follow up of fractured vertebrae treated by percutaneous vertebroplasty.⁷

Which patients are suitable for treatment?

Patient selection is an important issue for percutaneous vertebroplasty (see the box on page 79). Patients whose pain is not due to vertebral fracture will not respond to this treatment.

To help determine which patients are suitable for treatment, both preprocedure bone scanning and MRI have been evaluated. Increased activity revealed by bone scan was shown to be indicative of a positive response following the procedure when evaluated in a retrospective chart review.¹² MRI can determine if a crush fracture is present, and has the additional advantage of being able to exclude other pathology.¹³

What are the contraindications?

There are contraindications to the procedure. Coagulation disorders are an absolute contraindication due to the risk of bleeding near the injection site. Relative contraindications include a greater than one-third loss in vertebral height as this may lead to technical difficulties; consultation with a radiologist is required in such cases. Neurological symptoms are another relative contraindication as these may be worsened by vertebroplasty.^{1,3}

What are the risks?

Percutaneous vertebroplasty is not without risks. Problems noted in the short term include fever and a transitory exacerbation of pain.⁸

Pulmonary embolism of cement as the polymethylmethacrylate enters the perivertebral circulation has been reported, with no clinical problem in some cases. In other cases, anticoagulant

treatment has been necessary.^{6,14}

Leakage of polymethylmethacrylate into the spinal canal resulting in canal or foraminal stenosis has been noted and required decompression laminectomy.^{15,16} The leakage of cement can be minimised by injecting it in a viscous form.¹⁵ In long term follow up, Grados and colleagues showed an increased risk of fracture in vertebrae adjacent to those treated by percutaneous vertebroplasty. This is thought to be due to changes in the normal load transmission.⁸

Infection is another potential complication, but at this stage it has not been seen.²

It should be noted that this therapy does not replace the need for ongoing osteoporosis treatment to reduce the risk of fracture.

Summary

Percutaneous vertebroplasty is a recently introduced effective treatment for pain from osteoporotic vertebral fracture that is refractory to conservative therapy. Patient selection and an experienced operator are both important parts of minimising potential risks and maximising benefit.

MT

References

1. Cortet B, Cotten A, Boutry N, et al. Percutaneous vertebroplasty in the treatment of osteoporotic vertebral compression fractures: an open prospective study. *J Rheumatol* 1999; 26: 2222-2228.
2. Mathis JM, Petri M, Naff N. Percutaneous vertebroplasty treatment of steroid-induced osteoporotic compression fractures. *Arthritis Rheum* 1998; 41: 171-175.
3. Diamond TH, Clark WA. Percutaneous vertebroplasty: a novel treatment for acute vertebral fractures. *Med J Aust* 2001; 174: 398-400.
4. Galibert P, Deramond H, Rosat P, Le Gars D. [Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty]. *Neurochirurgie* 1987; 33: 166-168.
5. Kaemmerlen P, Thiesse P, Bouvard H, Biron P,

Mornex F, Jonas P. [Percutaneous vertebroplasty in the treatment of metastases. Technique and results]. *J Radiol* 1989; 70: 557-562.

6. Jensen ME, Evans AJ, Mathis JM, Kallmes DF, Cloft HJ, Dion JE. Percutaneous polymethylmethacrylate vertebroplasty in the treatment of osteoporotic vertebral body compression fractures: technical aspects. *AJNR Am J Neuroradiol* 1997; 18: 1897-1904.
7. Cyteval C, Sarrabere MP, Roux JO, et al. Acute osteoporotic vertebral collapse: open study on percutaneous injection of acrylic surgical cement in 20 patients. *AJR Am J Roentgenol* 1999; 173: 1685-1690.
8. Grados F, Depriester C, Cayrolle G, Hardy N, Deramond H, Fardellone P. Long-term observations of vertebral osteoporotic fractures treated by percutaneous vertebroplasty. *Rheumatology (Oxford)* 2000; 39: 1410-1414.
9. Deramond H, Wright NT, Belkoff SM. Temperature elevation caused by bone cement polymerization during vertebroplasty. *Bone* 1999; 25 (2 Suppl): 17S-21S.
10. Belkoff SM, Maroney M, Fenton DC, Mathis JM. An *in vitro* biomechanical evaluation of bone cements used in percutaneous vertebroplasty. *Bone* 1999 (2 Suppl); 25: 23S-26S.
11. Dean JR, Ison KT, Gishen P. The strengthening effect of percutaneous vertebroplasty. *Clin Radiol* 2000; 55: 471-476.
12. Maynard AS, Jensen ME, Schweickert PA, Marx WF, Short JG, Kallmes DF. Value of bone scan imaging in predicting pain relief from percutaneous vertebroplasty in osteoporotic vertebral fractures. *AJNR Am J Neuroradiol* 2000; 21: 1807-1812.
13. Do HM. Magnetic resonance imaging in the evaluation of patients for percutaneous vertebroplasty. *Top Magn Reson Imaging* 2000; 11: 235-244.
14. Padovani B, Kasriel O, Brunner P, Peretti-Viton P. Pulmonary embolism caused by acrylic cement: a rare complication of percutaneous vertebroplasty. *AJNR Am J Neuroradiol* 1999; 20: 375-377.
15. Harrington KD. Major neurological complications following percutaneous vertebroplasty with polymethylmethacrylate: a case report. *J Bone Joint Surg Am* 2001; 83-A: 1070-1073.
16. Ratliff J, Nguyen T, Heiss J. Root and spinal cord compression from methylmethacrylate vertebroplasty. *Spine* 2001; 26: E300-E302.