



Review article

Surgical techniques and clinical evidence of vertebroplasty and kyphoplasty for osteoporotic vertebral fractures

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ABSTRACT

Osteoporotic vertebral fracture is a disease condition with high morbidity and mortality, whose prevalence rises with mean increase in the life span. Conventional treatments for an osteoporotic vertebral fracture include bed rest, pain medication and brace implementation, but if the patient's pain is severe, cement augmentation procedures, including vertebroplasty and kyphoplasty, are performed. Vertebroplasty and kyphoplasty are relatively easy procedures that have been reported to be effective in controlling acute pain. But, the risk of complication and additional adjacent segment fracture and their superiority over conventional treatment remain debatable. Therefore, the authors have summarized the procedures, complications, and clinical evidence of vertebroplasty and kyphoplasty in this review.

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1. Introduction

Although an osteoporotic vertebral fracture (OVF) produces mild symptoms occasionally, most of the times, it causes severe back pain which severely limits patients' behavior and causes public health problems including decreased quality of life and increased medical cost [1,2]. Additionally, it has been reported that an OVF increases mortality [3,4]. Long-term bed rest can increase the risk of various complications, especially in elderly patients; therefore it is critical to use proper pain medication to ensure their mobility. It has been known that commonly used nonsteroidal anti-inflammatory drugs have limited effect on reducing the pain caused by fracture. Other medications for severe pain include opioid-medication, which can cause complications like nausea, vomiting, giddiness, decreased respiratory function, and can increase the risk of falling in elderly patients. Therefore, the medication should be

administered with caution and patients should be followed up positively. Implementation of a brace is another conservative treatment, but old aged patients have lower compliance than young patients, which decreases the effectiveness of the brace. Also, the brace has a disadvantage that it presses the thorax, which limits the user's respiratory function. Therefore, if no significant improvement is observed after several weeks of positive conservative treatment, cement augmentation procedure like injecting polymethylmethacrylate (PMMA) cement into a fractured vertebral body could be an effective treatment [5]. The indication of percutaneous cement augmentation is painful osteoporotic or neoplastic vertebral compression fractures refractory to medical therapy. Cement augmentation has the advantages of ensuring minimal invasion with the percutaneous technique and a relatively short operation time, and therefore, it is used more frequently. Two cement augmentation procedures were widely used, vertebroplasty (VP) and kyphoplasty (KP). In VP, operators insert J-type needles into vertebrae and inject cement, while in KP, the cement was injected after the collapsed vertebrae were expanded with balloons.

To conduct the cement augmentation procedure, the diagnosis of an OVF with a plain radiograph and the diagnosis of a recent fracture with magnetic resonance imaging (MRI) are needed. In case MRI is not available, sagittal reconstruction computed

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tomography and bone scan can be used together to diagnose a recent fracture. Coagulation disorders, infection, and vertebral osteomyelitis are contraindications for VP and KP. In other conditions, like severe posterior displacement of a fractured segment, a lytic lesion in the posterior vertebral wall and a significant defect, the risk of vertebral canal compression is very high, and therefore, they are also contraindications for VP and KP.

Recently, some research has reported that there was no significant difference in the effect of pain reduction between sham injection and VP, which provoked a debate on the usefulness of VP and KP. But according to the meta-analyses reported later, more results showed that VP and KP had an effect of achieving short-term pain control [5–8]. Therefore, this review reports the technical aspects of VP and KP with respect to reduced leakage of PMMA cement, uniportal approach for multiple fractures and KP technique for severe compression fractures.

2. The VP procedure

The basic equipment required for performing VP includes beveled trocars (J-type needle, etc.) PMMA cement, contrast media and a fluoroscope. Patients are positioned in the prone position and they normally receive local anesthesia. A commonly used anesthetic is lidocaine. It is important to position the patients in the true anterior-posterior (AP) and lateral positions since the position of the trocar is critical in these procedures. Additionally, 1 or 2 fluoroscopes should be used to affirm the position of the trocar during the procedure. Nerve tissue might be injured if the trocar invades into the medial side of the pedicle, which should receive increased attention.

A frequently used approach is the transpedicular approach, and the extrapedicular posterolateral approach is used occasionally [9]. Compared to the extrapedicular posterolateral approach, the transpedicular approach has a needle pathway which locates the needle in the vertebral body through a pedicle pathway. The transpedicular approach has advantages of avoiding pleural parenchymal injury, lumbar psoas hematoma and cement leakage by lowering risk of cement leakage through a puncture hole.

2.1. Transpedicular approach

After locating the skin incision 1–1.5 cm lateral to the pedicle lateral margin, a trocar is positioned on the lateral margin of the pedicle using a fluoroscopic AP image. The position should ideally be located at the center or mildly superior to the center of the pedicle. The trocar should be advanced through the pedicle to the posterior margin of the vertebral body, while maintaining the convergence and monitoring with fluoroscopy. The trocar tip should not invade the medial margin of the pedicle on an AP image (Fig. 1). Afterwards, the position of the trocar tip should be checked, and it should be advanced to the anterior 1/5th–1/4th of the vertebral body and the contrast agent should be injected to check for vascular leakage. If vascular leakage is severe, then the position of the trocar tip should be changed and the presence of vascular leakage should be checked again with a contrast agent injection. After that procedure, PMMA cement should be injected slowly (Fig. 1).

2.2. Extrapedicular posterolateral approach

Extrapedicular posterolateral approach can be used in conditions wherein it is difficult to perform the pedicle approach, like patients having a small pedicle, pedicular lysis or instruments like a pedicle screw [10]. Skin incision should be located 4th–5th finger width lateral to the spinous process. When performing this

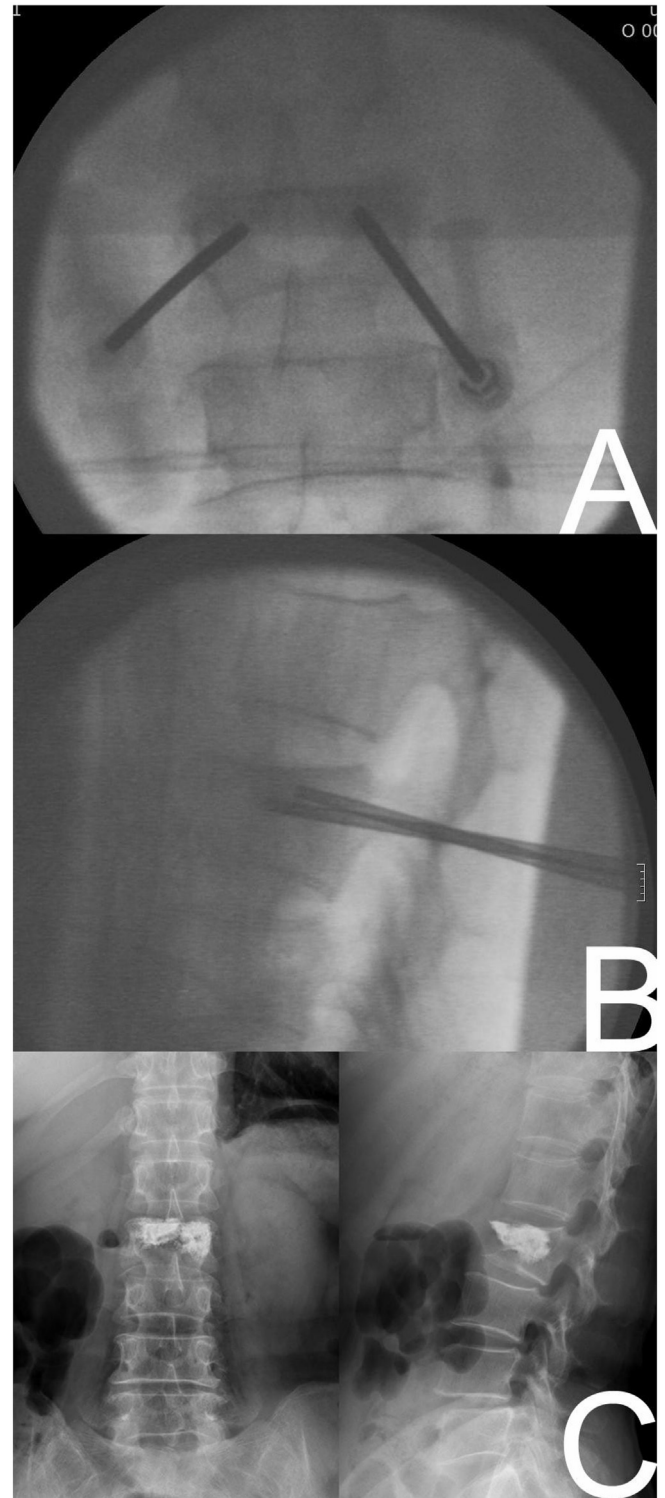


Fig. 1. The vertebroplasty procedure. (A) A J-type needle is positioned at the lateral aspect of the pedicle. (B) A J-type needle is positioned into the vertebral body without invading the medial margin of the pedicle. (C) Image after cement injection.

approach in the thoracic spine, pleural injury and hemothorax should be avoided. The trocar should be located on the anterior 1/5th–1/4th of the vertebral body and cement leakage should be assessed, if it is severe, the position of the trocar tip should be changed, and leakage should be rechecked, as previously described.

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