

Clinical Article

The Retrial of Percutaneous Vertebroplasty for the Treatment of Vertebral Compression Fracture

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Objective : For the treatment of osteoporotic vertebral compression fracture, percutaneous vertebroplasty (PVP) is currently widely used as an effective and relatively safe procedure. However, some patients do not experience pain relief after PVP. We performed several additional PVP procedures in those patients who did not have any improvement of pain after their initial PVP and we obtained good results. Our purpose is to demonstrate the effective results of an additional PVP procedure at the same previously treated level.

Methods : We reviewed the medical records and the radiologic data of the PVP procedures that were performed at our hospital from November 2005 to May 2008 to determine the patients who had undergone additional PVP. We identified ten patients and we measured the clinical outcomes according to the visual analogue scale (VAS) score and the radiologic parameters, including the anterior body height and the kyphotic angulation.

Results : The mean volume of polymethylmethacrylate injected into each vertebrae was 4.3 mL (range: 2-8 mL). The mean VAS score was reduced from 8 to 2.32. The anterior body height was increased from 1.7 cm to 2.32 cm. The kyphotic angulation was restored from 10.14 degrees to 2.32 degrees. There were no complications noted.

Conclusion : The clinical and radiologic outcomes suggest that additional PVP is effective for relieving pain and restoring the vertebral body in patients who have unrelieved pain after their initial PVP. Our study demonstrates that additional PVP performed at the previously-treated vertebral levels could provide therapeutic benefit.

KEY WORDS : Percutaneous vertebroplasty · Vertebral compression fracture · Unrelieved pain.

INTRODUCTION

Vertebral compression fractures (VCFs) are known to be the most common complication of osteoporosis. Osteoporotic VCFs can be a serious burden for old patients by impairing their ordinary physical activity. The general management for these VCFs includes bed rest, pain medication, bracing and rehabilitation. Although such conservative treatments may be partially valid, it is known that about one third of these patients suffer from persistent pain and they show progression of their functional limitations and loss of mobility^{1,2,7,14}. Further, a long period of bed rest can lead to demineralization of bone and this may predispose these patients to further fracture. Whether or not the VCF is

painful, conservative treatments do not prevent kyphotic deformity. Percutaneous vertebroplasty (PVP) has been developed to prevent kyphotic deformity of the spine and to decrease the back pain. PVP is currently recognized as a standard treatment modality for painful osteoporotic VCFs. It provides excellent results for osteoporotic VCFs with relatively few complications. Remarkable pain relief has been reported in about 80-95% of the patients with osteoporotic VCFs and who are treated with PVP^{1,14,15,18}. Unrelieved pain after PVP is uncommon, and this has been reported in about 5% to 22% of the cases^{4,7}. The purpose of our study is to demonstrate that performing additional PVP at the previously treated vertebral levels for alleviating the unrelieved pain can provide substantial therapeutic benefit.

MATERIALS AND METHODS

We conducted a retrospective review of the medical records on the PVPs that were performed in our institution to define

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a population of patients that underwent additional PVP for their unrelieved pain. Between November 2005 and May 2008, 1,057 cases were diagnosed with osteoporotic VCFs, and ten patients received additional PVP at the previously-treated level due to unrelieved pain after the initial PVP. Almost all the recurrent pain after PVP usually represents newly developed fractures at other different vertebral levels. We excluded these subsequent VCFs at other vertebral levels. For those patients with unrelieved pain, we reevaluated them with X-rays, computed tomography (CT) and magnetic resonance image (MRI). We treated them with conservative techniques such as analgesics, medial branch blocks and applying a back brace. Despite the conservative treatments, their pain did not improve. So, we decided to perform additional PVP at the same vertebra in the patients who were refractory to conservative treatments. All the patients treated by initial PVP were prescribed with osteoporosis medication, including biphosphonate, vitamin D and calcium. The clinical and radiologic outcomes were assessed by using the preoperative and postoperative visual analogue scale (VAS) score and such parameters as the preoperative and postoperative anterior body height and the preoperative and postoperative kyphotic angulation. The kyphotic angulation was measured by the angulation of the lower end plate lines between the upper vertebra and the involved vertebra on the lateral radiographs. The technique for additional PVP was similar to that of the initial procedure. PVP was performed by the unilateral or bilateral transpedicular approach, which was determined by the symptoms and the MRI findings. We prefer the direction on the side where the more severe pain is located. Polymethylmethacrylate (PMMA) cement (DePuy International Ltd., UK) was mixed with barium sulfate powder, and this was allowed to polymerize to a toothpaste-like density. The PMMA was carefully injected by monitoring the procedure with a C-arm fluoroscope to check for cement leaks into

the neural canal or the venous channel.

RESULTS

The characteristics of the patients who underwent an additional PVP procedure are shown in Table 1. They consisted of eight women and two men, and their mean age was 75 years (range : 65-82 years). All patients had severe osteoporosis, as was confirmed by their bone mineral density (mean T score : -5.3, range : -3.26 - -5.76). These patients were prescribed risedronate and calcium carbonate mixed with vitamin D in order not to aggravate the osteoporosis. The mean period between the two procedures was 114 days (range : 16-710 days). The mean amount of injected cement was 4.2 mL (range : 2-8 mL). The thoracolumbar areas were mostly involved (T6 : 1 case, T12 : 3 cases, L1 : 2 cases, L2 : 3 cases, L3 : 1 case). Four patients received their initial PVP at other hospitals and six patients received their initial PVP at our hospital. Seven patients among these patients were revealed to have avascular necrosis (AVN) of the vertebral body at the previously treated level on the rechecked MRI. Their images showed high signal intensity on the T2 weighted image and low signal intensity on the T1 image of the sagittal and axial MRIs, and this was suggestive of a fluid collection. There were no other subsequent fractures. During the additional PVP, the bone cement was well injected along the cavity that was made by the fluid collection. We were able to confirm the restoration of the kyphotic angulation by the postoperative radiographs. All the patients showed improvement for their pain and mobility.

The anterior vertebral body height (preoperative: 1.7 cm \pm 0.56 and postoperative : 2.32 \pm 0.43 cm) and the kyphotic angulation (preoperative : 10.14 \pm 4.35 degrees and postoperative : 2.32 \pm 3.21 degrees) were restored. The VAS score for back pain was improved from 8 to 2.6. No serious complications related to the procedure occurred.

Table 1. The patients' characteristics

	1	2	3	4	5	6	7	8	9	10
Sex	F	F	F	M	F	F	M	F	F	F
Age	82	78	65	79	76	82	76	81	65	65
Level	L1	T12	L2	T12	L1	L2	T12	L2	T6	L3
Interval (days)	710	71	111	72	20	16	36	30	41	36
Cement 1st (mL)	4.5	*	*	*	6	6	5	*	1.5	5
Cement 2nd (mL)	4	5	3	8	6	4	4	4.5	2	2.5
MRI findings	Fluid	Fluid		Fluid	Fluid	Fluid	Fluid	Fluid		
Approach 1st	Lt	Both	Both	Both	Lt	Both	Lt	Both	Lt	Rt
Approach 2nd	Lt	Rt	Lt	Rt	Rt	Both	Both	Both	Rt	Lt
F/U period (months)	21.6	31	30.6	25.5	25	12	12.5	12	12	34

*The exact amount of cement injected could not be checked, because the initial PVPs were done at other hospital. F/U : follow up, PVP : percutaneous vertebroplasty

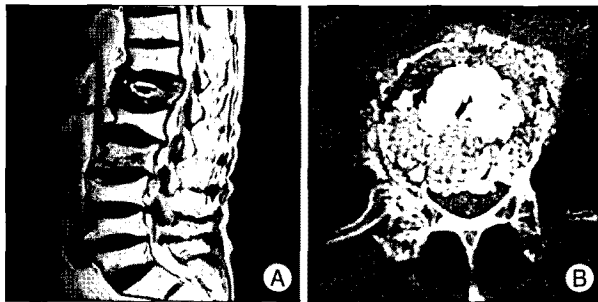


Fig. 1. Preoperative MRI (A) shows the fluid collection around the bone cement, and preoperative CT (B) shows the scattered cement with vacuum at T12 level.

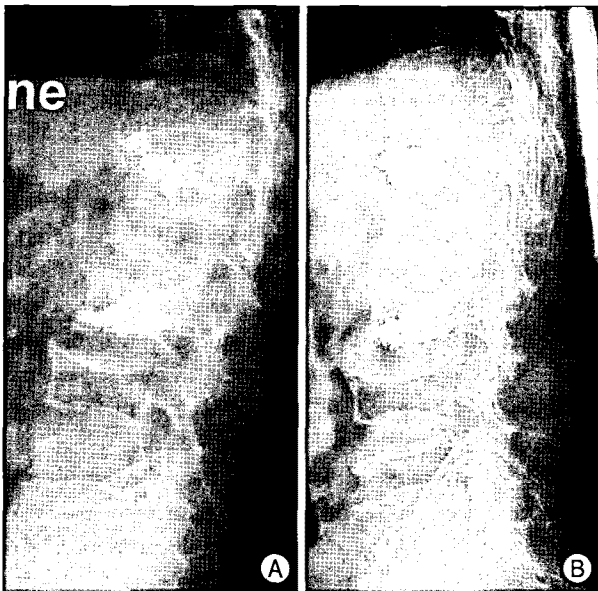


Fig. 2. Preoperative (A) and postoperative (B) radiographs show the filling of cement and improvement of kyphotic angulation at T12 level.

DISCUSSION

The back pain of osteoporotic VCFs may be related to the intraosseous or periosteal nerves being worsened by their motion around the fracture site. This has been supported by studies in which PVP increases the vertebral body strength and stiffness^{2,16}. Although PVP is usually effective to provide pain relief, a few patients experience no improvement of their pain after PVP. There have been only a few articles that have focused on those patients who failed to respond to the PVP and the causes of this failure to respond to PVP were not clarified^{4,7,10}. Some biomechanical tests have suggested that the strength and the stiffness of the vertebral body are weakly correlated with the volume of injected cement¹³. Nevertheless, a sufficient amount of cement may be necessary for pain relief in at least some patients. We thought that an inadequate amount of injected cement may be one of the causes of unrelieved pain. Unrelieved pain after the initial PVP may have other causes as

well. In most of the additional PVP cases reported in the literature, the preoperative MRI images showed a fluid collection, which means AVN of the vertebral body^{3,5,8,11}. AVN is a known disease entity and various terms have been used to name it, such as intravertebral vacuum cleft, intravertebral pseudoarthrosis, vertebral osteonecrosis, vertebral fluid collection associated with vertebral collapse, delayed post-traumatic vertebral collapse and Kummell's disease^{8-11,15}. Maldague et al.¹² first described the intravertebral vacuum cleft phenomenon as the accumulation of gas within a vertebral body, which was defined as a pathognomonic sign for AVN. AVN can also be caused by malignancy, infection, radiotherapy, steroid treatment and other systemic diseases. In our cases, there were no past or present histories of any of the conditions mentioned above, except trauma. We think that AVN of the vertebral body is closely related to the re-collapse of the vertebral body. Performing the PVP can not prevent the progression of AVN of the vertebral body. So, although we conducted the PVP, AVN of the vertebral body may have progressed and caused a re-collapse of the vertebral body. The re-collapse of the vertebral body may be a cause of unrelieved pain despite performing the cement augmentation procedure. Heo et al.⁶ reported that eleven patients out of a total of 343 had a re-collapse of the same vertebra after PVP for an approximate 3% incidence rate. They suggested that osteonecrosis is one of the important predisposing factors for the re-collapse of a vertebral body. The incidence rate of vertebral re-collapse was significantly higher for the patients with osteonecrosis than that for the patients without osteonecrosis (28.57% vs. 1.24%, respectively). He et al.⁷ reported that additional PVP achieved excellent pain relief in all fifteen patients of their study. All the patients had improved mobility and they stopped their use of analgesics within 24 hours after additional PVP. Among the fifteen patients, four patients had a vacuum cavity filled with fluid, which can be called AVN. They suggested the cause of the unrelieved pain after PVP to be the absence or inadequate filling of cement in the unstable fractured areas of the vertebral body. They emphasized that a sufficient amount of cement should to be injected into the area that is responsible for the pain for the successful treatment of osteoporotic VCFs. Other authors have mentioned some strategies after the initial failure of PVP to treatment VCFs, such as additional PVP or the anterior or posterior approached fusion techniques²⁰. However, the patients enrolled in this study were elderly and they had severe osteoporosis. Instead of fusion, we performed additional PVP, which is a relatively safe and minimally invasive procedure, and we obtained good results. The trajectory route in our additional PVP proce-

dures was decided upon with considering where the patients felt the most pain and where the cement was least filled, as assessed on MRI. We tried to position the needle as close to the center of the vertebral body as possible under the guidance of a fluoroscope. However, for cases where the needle positioning was in an unwanted direction, a transpedicular approach was taken on both sides^{17,19}. In most of our cases where fluid existed, the cement was inserted into the cavity created by the aspiration, and even if the fluid was not fully aspirated, the overall procedure was smoothly carried out. During the additional PVPs, these procedures were safely and feasibly performed without any complications.

There are some limitations in this study. The number of cases enrolled in our study was not sufficient to assess the statistical outcome. The causes of the unrelieved pain after PVP were not definitely proven and the rationales for the efficacy of additional PVP are perhaps insufficient. Yet in our study, all the patients treated with additional PVP experienced an considerable improvement of their pain. Though the mechanism of the pain relief for additional PVP remains elusive, performing the additional PVP may be an effective therapeutic option prior to performing fusion. When we do not obtain enough pain relief after PVP, then additional PVP could be one of the treatment options for the successful management of VCFs.

CONCLUSION

For the cases of unrelieved pain after PVP, a retrial of additional PVP can be considered after conservative treatment has failed. The clinical outcomes of our study suggest that repeat PVP performed at the previously-treated vertebral levels for unrelieved pain provides excellent therapeutic benefit.

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