CLINICAL ARTICLE

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Open Kyphoplasty Combined with Microscopic Decompression for the Osteoporotic Burst Fracture

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Objective : The purpose of this retrospective clinical study was to describe a treatment for osteoporotic burst fracture in the setting of severe fractures involving fragmentation of the posterior wall and neural compromise with symptoms of cord compression.

Methods : Indication for microscopic decompression and open kyphoplasty were intractable pain at the level of a known osteoporotic burst fractures involving neural compression or posterior wall fragmentation. A total of 18 patients (mean age, 74.6 years) with osteoporotic thoracolumbar burst fractures (3 males, 15 females) were included in this study. In all cases, microscopic decompressive laminectomy was followed by open kyphoplasty. Clinical outcome using VAS score and modified MacNab's grade was assessed on last clinical follow up (mean 6.7 months). Radiological analysis of sagittal alignment was assessed preoperatively, immediately postoperatively, and at final follow up.

Results : One level augmentation and 1.8 level microscopic decompression were performed. Mean blood loss was less than 100 ml and there were no major complications. The mean pain score before operation and at final follow up was 7.2 and 1.9, respectively. Fourteen of 18 patients were graded as excellent and good according to the modified MacNab's criteria. Overall, 6.0 degrees of sagittal correction was obtained at final follow-up.

Conclusion : The combined thoracolumbar microscopic decompression and open kyphoplasty for severe osteoporotic fractures involving fragmentation of posterior wall and neural compromise provide direct visualization of neural elements, allowing safe cement augmentation of burst fractures. Decompressive surgery is possible and risk of epidural cement leakage is controlled intraoperatively.

KEY WORDS : Osteoporosis · Burst fracture · Microscopic decompression · Kyphoplasty.

Introduction

Both vertebroplasty and kyphoplasty have been safely used in the treatment of vertebral compression fractures, with rapid pain relief reported in the majority of patients[6]. Kyphoplasty, by virtue of inflatable bone tamps (IBT), has been reported to restore the vertebral height and reduce extravasation rates of cement[10]. However, symptomatic spinal cord compression as a result of a osteoporotic burst fracture has been cited as a contraindication for the use of percutaneous cement augmentation because of the potential for cement leakage and further neuologic deterioration by cord compression[1,3,4,8]. Traditional procedures for osteoporotic burst fractures with neurologic involvement entail spinal decompression and fusion with supplemental instrumentation. However, these surgeries are fraught with complications because of the difficult reconstruction in the setting of osteoporosis and because of the debilitated state of these elderly patients. Therefore, patients with osteoporotic burst fractures with canal compromise may be difficult to treat. The current retrospective study describes the results with microscopic decompression and open kyphoplasty without posterior instrumentation in patients with osteoporotic burst fractures.

Materials and Methods

Between 2003 and 2005, 18 patients (3 males, 15 females) with osteoporotic thoracolumbar burst fractures with symptomatic neural compression were treated by microscopic decompression and open kyphoplasty. The mean age of the

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patients was 74.6 years (range, 62 to 80 years). Indications for decompression and cement augmentation were intractable back pain at the level of a recent osteoporotic burst fracture with concomittent compression induced neurologic deficits. In all cases, microscopic decompressive laminectomy of the stenotic fractured level was followed by open kyphoplasty.

Technique

Microscopic decompressive laminectomy was performed at the level of the fractured vertebral body identified on imaging studies that correlated with the patient's symptom. After decompressive laminectomy, open kyphoplasty was performed under fluoroscopic guidance. When kyphoplasty was performed, two cannulae were passed in a transpedicular route into affected vertebral body. Inflatable bone tamps (Kyphon, Sunnyvale, CA) were then expanded under fluoroscopic visualization until fracture reduction occurred, the IBT contacted a cortical wall, or the recommended maximal IBT pressure or volumes were reached. Because the retropulsed bone, the IBT was placed within the anterior half of the vertebral body, theoretically reducing the risk of further retropulsion. The PMMA was partially cured and then introduced through the bone void filler tool. During vertebral augmentation, the posterior vertebral body wall and neural element were directly visualized to ensure no further retropulsion and cement leakage. Clinical outcome was assessed at immediate postoperatively and at final clinical follow-up. Patients rated their pain on the visual analogue scale (0=no pain to 10=imaginable severe pain) prior to surgery, 2 days after surgery, and at final follow up. Patients were stratified according to modified MacNab's criteria. Lateral plain radiographs were obtained preoperatively, immediately after the open kyphoplasty, and at final follow up. Radiological measurement of preoperative and at postoperative sagittal plane angulation after the procedure. For determination of the kyphotic angle, measurements were taken from the intersection of superior and inferior endplate of the fractured body. Comparisons between different time points were done using paired student's test. Differences were considered as statistically significant with p value less than 0.05.

Results

With respect to anatomic distribution of fractures, T12 was the most commonly fractured level (n=6), followed by L1 (n=3), L2 (n=3), L3 (n=3), T11 (n=2), and T10 (n=1). The mean clinical follow-up was 6.7 months. The mean pain score immediately before operation was 7.2 (range 4-9) and the mean pain score immediately after operation was 1.9. The mean pain score at final follow up (3-12 months) was 1.9. There were no worsening of symptoms. The average preoperative, immediate postoperative, and final follow-up kyphotic angles are listed in (Fig. 1, 2). The overall preoperative kyphotic angle was 12.6 degrees. Approximately 8.6 degrees of correction was obtained postoperatively in this series. At final follow-up, the average amount of correction obtained overall was 6.6 degrees, representing a 6.0 degrees change in angulation from the original. Fourteen out of 18 patients were graded as having a excellent or good result according to the modified MacNab's criteria (Table 1, 2).

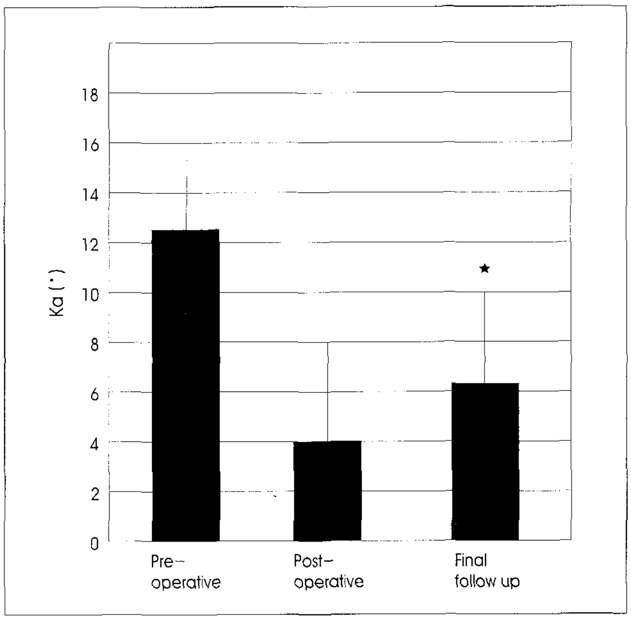

Fig. 1. Radiographic measurement of pre-and postoperative kyphotic angle. ★ $P<0.01$ for preoperative versus final follow up.

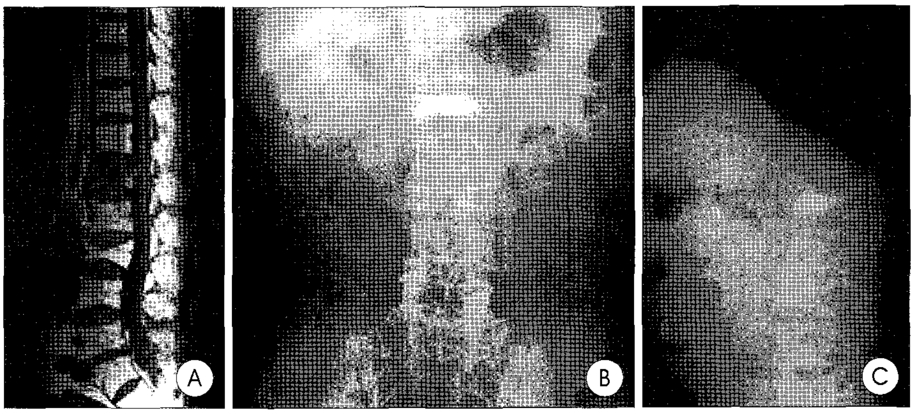

Fig. 2. *78-year-old female patient with osteoporotic burst fracture. A : T1-sagittal image shows spinal cord compression at L1 level. B, C : Postoperative simple radiographs showing good filling of cement augmentation.*

Table 1. Clinical of 18 patients with severe osteoporotic vertebral fractues

Case No.1	Age/ Sex	Fracture level	Back pain	Paraparesis	Mean follow up (months)
1	78/M	T12	+	+	8
2	74/F	L1	+	−	12
3	76/F	L2	+	+	4
4	76/F	L1	+	−	3
5	71/F	T10	+	−	6
6	69/F	T12	+	+	7
7	78/F	T12	+	+	8
8	79/F	L3	+	+	8
9	80/M	L3	+	−	3
10	78/F	T11	+	+	3
11	70/F	T12	+	+	4
12	69/F	L3	+	−	7
13	66/F	L2	+	−	8
14	79/F	L1	+	−	6
15	77/F	L2	+	−	7
16	74/M	T12	+	+	8
17	75/F	T12	+	+	7
18	73/F	T11	+	+	7

Table 2. Modified MacNab outcome assessment of patient satisfaction with the surgical procedure at final clinical follow-up

Outcome	Description of criteria	Number of patients
Excellent	No pain; no restriction of mobility; return to normal work & level of activity	10
Good	Occasional nonradicular pain; relief of presenting symptoms; return to modified work	4
Fair	Some improved functional capacity; still hadnicapped and unemployed	4
Poor	Continued objective symptoms of root involvement; additional operative intervention needed at the index level irrespective of length of postoperative follow-up	0

The mean injected cement volume was 5.2ml (range 3.3~6.8ml). Radiographic complications include polymethylmethacrylate (PMMA) leakage into adjacent discs (2 cases of 18, 11%) and paravertebral soft tissues (3 cases of 18, 16%). There were no major complications such as epidural leakage.

Discussion

Elderly patients with osteoporotic burst fractures and concomitant cord compression are very difficult to treat. Spinal canal compromise and cord compression have been cited as relative contraindication of vertebroplasty or kyphoplasty by other publications[4,8]. Such limitations listed in publication include pressure of bone fragments on the spinal cord and canal narrowing of greater than 20%[11]. Surgical decompression with instrumentation and fusion across the fractured segment has a high risk of fusion failure in osteoporotic bone. This study suggests the feasibility and safety of combining decompression of the neural elements with vertebral augmentation of the fractured vertebra. In addition to reducing fracture pain, vertebral augmentation restores the integrity of the anterior column, thereby reducing the risk of progressive deformity. With a burst component to the fracture and neurologic symptoms, direct decompression of the involved neurologic elements may be required. Recently, case reports of vertebral augmentation combined with surgical decompression of the fractured level have been published. Boszczyk et al.[2] reported experience with interlaminary vertebroplasty and kyphoplasty performed in 24 patients with osteoporotic fractures with nerual compression or posteror wall fragmentation. After unilateral microsurgical fenestration at the fracture level, decompression of the spine, and gentle mobilization of the thecal sac, vertebroplasty or kyphoplasty was performed directly through the posteror wall of the fracutred vertebral body with fluoroscopic control. Gaitanis and associates reported on 32 patients with vertebral compression fractures and concomitant spinal stenosis identified on preoperative magnetic resonance images[5]. Hsiang described the use of open kyphoplasty and decompressive laminectomy at T12 for a painful osteoporotic vertebral body compression fracture in a 79-year-old female[8]. These patients underwent percutaneous kyphoplasty followed by a staged laminectomy for the spinal stenosis with resolution of the symptoms. Guelbenzu et al.[7] described the use of vertebroplasty followed by subsequent bilateral laminectomy to decompress the spinal cord from a compressive hemangioma. After the open kyphoplasty, the fracture was successfully reduced without cement leakage. In our series, 6.0 degrees of sagittal correction was obtained at final follow up. This may be due to vertebral fractures at the thoracolumbar junction where significant wedging and kyphosis often occur, which may be successfully reduced with kyphoplasty. Microscopic decompressive laminectomy and opentranspedicular cement augmentation by kyphoplasty may be an invaluable treatment option in patients who are incapacitated from fracture pain accompanying concomitant cord compression. Direct visualization of the posterior vertebral body wall and neural elements after thoracolumbar decompression may allow for safe cement augmentation of burst fractures, thus stabilizing the spine and obviating the need for extensive spinal reconstruction.

Limitations of this study include its retrospective design and small sample size. In addition, the follow-up time was limited. Therefore, large prospective and randomized controlled studies should be performed to further substantiate our findings.

Conclusion

Combined microscopic decompression and open kyphoplasty provides direct visualization of neural elements, allowing for safe cement augmentation of burst fractures. The use of this technique is considered a safe treatment option for patients who have osteoporotic burst fractures.

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Commentary

The patients with osteoporotic burst fractures and concomitant cord compression are difficult to treat, because of spinal canal compromise and cord compression. And it have been regarded as relative contraindication of vertebroplasty or kyphoplasty. and surgical decompression with instrumentation and fusion over the fractured segment has a high risk of fusion failure in osteoporotic bone.

Vertebral augmentation restores the integrity of the anterior column reducing the risk of progressive deformity with pain reduction. Authors suggest that decompressive laminectomy and open-transpedicular cement augmentation by kyphoplasty may be an invaluable treatment option in patients who are incapacitated from fracture pain accompanying concomitant cord compression. And direct visualization of the posterior vertebral body wall and neural elements after thoracolumbar decompression may allow for safe cement augmentation of burst fractures, but microscopic laminectony is enough to decompress the bursted neural element. And if injected cement leakage out into the spinal canal, surgeons may hesitate to open the spinal canal especially in thoracic level. And vertebral body cement argumentation may be not enough to sustain the osteoporotic spine external loads in biomechanic aspects. This study suggests the feasibility and safety of combining decompression of the neural elements with vertebral augmentation of the fractured vertebra.

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