

# Functional Results of Vertebral Augmentation Techniques in Pathological Vertebral Fractures of Myelomatous Patients

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**Introduction:** This is a retrospective study to determine the effects of vertebroplasty and kyphoplasty on quality of life in multiple myeloma patients with spinal compression fractures.

**Material and Methods:** Thirty-four patients with primary multiple myeloma were treated for symptomatic compression fractures between June 2003 and June 2005. Kyphoplasty was applied to 22 levels in 18 and vertebroplasty to 28 levels in 16 patients.

The pain-related disability was evaluated for every single daily living activity using visual analog scale (VAS) over 10 points. (pain at rest, walking, sitting-standing, taking a shower and wearing clothes). (This evaluation is performed to every patient with degenerative disorders of the spine upon admission to our clinic.) Overall VAS scores were evaluated over 50 points (0 minimum, 50 maximum) preoperatively, at postoperative six weeks, six months and at one year prior to taking analgesics. The amount of analgesic use was recorded. Data was analyzed statistically using variance analysis, Friedman's multiple comparison test and Student's *t* test.

**Results:** The mean overall pain score in the kyphoplasty group decreased from a preoperative value of 36 to 12.13 at the sixth postoperative week, to 8.63 at the sixth month and to 9.72 at one year. ( $p < 0.001$ ).

The mean overall pain score in the vertebroplasty group decreased from a preoperative value of 37.83 to 15.33 at the sixth postoperative week, to 12.17 at sixth months and to 13.47 at one year. ( $p < 0.001$ ).

Student's *t* test was used to analyze the percentage of differences in overall pain score. Difference between groups was not statistically significant at the sixth week ( $p = 0.106$ ) but was statistically significant both at the sixth month ( $p = 0.024$ ) and at one year ( $p = 0.027$ ) in favor of kyphoplasty group.

No secondary collapse was observed in adjacent levels in both groups. There were no intrapostoperative neurologic/pulmonary complications in both groups. Analgesics usage significantly decreased in both groups.

**Conclusion:** In multiple myeloma, when pathological spinal compression fractures cause intractable pain and are unresponsive to conservative treatment, both vertebroplasty and kyphoplasty are effective in increasing quality of life and decreasing pain.

**Key words:** multiple myeloma ■ compression fracture ■ kyphoplasty ■ vertebroplasty ■ functional result

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## INTRODUCTION

Multiple myeloma is a malignant plasma cell disorder and is closely related to osteolytic bone destruction.<sup>1</sup> Life expectancies of myeloma patients have improved with the new oncological treatment methods.<sup>2,3</sup> Skeletal metastases cause risk of fracture, especially in the spinal column, and resultant pain and deformities increase the morbidity of the disease. Vertebroplasty and kyphoplasty, which are used against vertebral body fractures and pain, help decrease these complications and additional deformities.<sup>4-6</sup> The aim of this study is to determine the effects of vertebroplasty and kyphoplasty procedures on quality of life in myelomatous patients with pathologic vertebral compression fractures.

## MATERIAL AND METHODS

Forty patients with a diagnosis of multiple myeloma who were treated for symptomatic compression fractures between June 2003 and June 2005 were retrospectively evaluated.<sup>4</sup> Patients with a history of an acute

traumatic event and two patients in whom the diagnosis of vertebral biopsy did not confirm myeloma metastasis were excluded from the study. As a result, this study included 34 patients with primary multiple myeloma that were treated for symptomatic compression fractures. All patients completed a questionnaire (described in detail below) regarding the difficulties in their daily living activities.

Eighteen patients underwent kyphoplasty and 16 vertebroplasty. All had been referred to us for treatment by the Department of Hematological Oncology and were having bisphosphonate treatment at the time of investigation.

The compression fractures were diagnosed with x-rays and MRI (Figure 1). Three patients had discal pathologies unrelated to the site of symptomatic levels, and none had canal stenosis.

Patients who had >50% compression (loss of >50% of vertebral height in lateral plain x-rays) underwent kyphoplasty (Figure 2), whereas the ones with <50% compression underwent vertebroplasty (Figure 3).

The mean age was 63.7 (48–82) in the kyphoplasty group and 62.16 (45–80) in the vertebroplasty group.

Kyphoplasty was applied to 22 levels (seven thoracic, 15 lumbar) in 18 patients (nine men, nine women). Vertebroplasty was applied to 28 levels (15 thoracic, 13 lumbar) in 16 (seven men, nine women) patients.

Both procedures were performed in the operating room under sedation with intravenous midazolam and with local anesthesia (1% lidocaine) in prone position. Biplanar-C arm fluoroscopy was used to determine the involved vertebrae, and all applications were done by unilateral transpedicular approach. As the patient was conscious throughout the operation, the information about pain and possible nerve root irritation and also

about symptoms of hemo/pneumothorax were gathered by verbal communication.

K wires were used to mark the pedicle, and Jamshidi biopsy needles were used to obtain biopsy material and bone marrow aspirate under fluoroscopy control for histopathological examination. For kyphoplasty, 15-mm kyphoplasty balloons were advanced through the cannula and expanded in the vertebral body until they touched the subchondral plate, lateral cortices and/or anterior cortex. Then polymethylmethacrylate (PMMA) (Surgical Simplex® P, Stryker Howmedica Osteonics) was mixed with barium and injected into the vertebral body through the cannula under fluoroscopic control. (The reason why Surgical Simplex is used is the unavailability of Spineplex™ in our country at that time.) Bone cement [2–6 ml (mean 4.3 ml)] was used for every single level.

Vertebroplasty was again performed under fluoroscopy control, and 2–4.5 ml (mean 3.3 ml) of bone cement, which was prepared in a similar fashion, was used for every single level. Following both procedures, the operative incision of 5 mm was sutured with a single stitch.

Regarding both procedures, if the patient planned to undergo more than two levels of application, the other levels were augmented after two days' interval. The reason why this method was chosen was to observe the possible side effects following the procedure. At most, four levels had undergone vertebroplasty in a single patient.

All patients had a chest x-ray taken following the procedure to rule out hemo/pneumothorax.

The mean operating time was 20 min (15–30 min) for vertebroplasty and 40 min (30–55 min) for kyphoplasty.

There was a balloon rupture in one of the kyphoplasty cases, which did not further complicate the procedure, and the operation was successfully completed in that patient. One patient had respiratory distress during the procedure,

**Figure 1. MRI of the patient showing multilevel vertebral compression fractures**



**Table 1. Overall VAS scores of kyphoplasty patients**

	Mean	Std. Deviation	N
VAS preop	36	4,504	18
VAS postop 6 weeks	12,13	3,603	18
VAS postop 6 months	8,63	2,326,8	18
VAS postop 12 months	9.72	2.437	18

**Table 2. Overall VAS scores of vertebroplasty patients**

	Mean	Std. Deviation	N
VAS preop	37.83	3.251	16
VAS postop 6 weeks	15.33	4.082	16
VAS postop 6 months	12.17	2.994	16
VAS postop 12 months	13.47	2.890	16

which originated from the sliding of the pads to the abdominal site and therefore caused compression of the abdomen (and indirectly the thoracic cavity). This was intraoperatively relieved with the repositioning of the pads. One patient had a superficial wound infection, which resolved with daily changes of wound dressing. No other complications were seen in other cases. All patients were mobilized on the same day following the procedure and discarded the very next day.

The pain-related disability was evaluated using a visual analogue scale (VAS) over 10 points. Patients were asked to evaluate their activities of daily living (pain at rest, walking, sitting-standing, taking a shower and wearing clothes)

with this pain score. The sum of overall VAS scores were evaluated over 50 points (0 minimum, 50 maximum). (Every patient admitted to our spine surgery department with a degenerative spine disorder completes this form.) Every patient completed this evaluation form preoperatively, at postoperative six weeks, at postoperative six months and one year, and especially prior to taking analgesics. Also, the amount of analgesic use was evaluated in the pre- and postoperative periods. The resultant data was analyzed statistically using variance analysis, Friedman's multiple comparison test and Student's t test.

**RESULTS**

The mean overall pain score in the kyphoplasty group decreased from a preoperative value of 36 (30–42) to 12.13 (6–16) at the sixth postoperative week, to 8.63 (5–12) at the sixth month and to 9.72 (6–13) at one year (Table 1). The difference was statistically significant ( $p < 0.001$ ).

The mean overall pain score in the vertebroplasty group decreased from a preoperative value of 37.83 (35–42) to 15.33 (10–20) at the sixth postoperative week and to 12.17 (8–16) at the sixth month and to 13.47 (8–17) at one year. (Table 2). The difference was statistically significant ( $p < 0.001$ ).

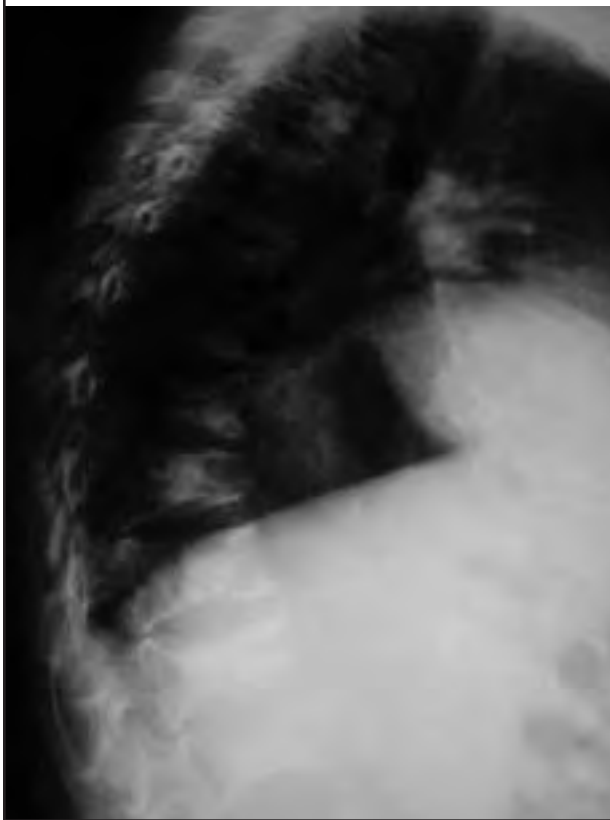
Student's t test was used to analyze the percentage of differences in pain scores.

In the kyphoplasty group, the pain had diminished by 66.8% at the sixth postoperative week, by 76.1% at the sixth postoperative month and by 73% at one year (Table 3). In the vertebroplasty group, the pain had diminished by 59.9% at the sixth postoperative week, by 68.1% at the sixth postoperative month and by 64.39% at one year (Table 3).

When the kyphoplasty and vertebroplasty groups were compared, the difference was not statistically significant at the sixth week ( $p = 0.106$ ), but there was statistically significant difference at the sixth month ( $p = 0.024$ ) and at one year ( $p = 0.027$ ).

No secondary collapse was observed in adjacent levels in both groups. There were no intraoperative or postoperative neurologic or pulmonary complications in either group.

**Figure 2. Patients with >50% compression underwent kyphoplasty**



**Table 3. Postoperative six weeks, six months and one year VAS differences in percentage when compared to preoperative levels**

	N	Mean Decrease in Percentage (%)
VAS Postop 6 Weeks		
Kyphoplasty	18	66.8%
Vertebroplasty	16	59.9%
VAS Postop 6 Months		
Kyphoplasty	18	76.1%
Vertebroplasty	16	68.1%
VAS Postop 12 Months		
Kyphoplasty	18	73%
Vertebroplasty	16	64.39%

In one of the kyphoplasty patients, there was a balloon rupture after full inflation, which did not further complicate the procedure, and the procedure was completed successfully.

The need to use analgesics was significantly decreased in both groups. The difference between the pre- and postoperative usages were all statistically significant (Table 4).

**DISCUSSION**

Osteolytic vertebral compression fractures increase morbidity and mortality by causing spinal deformity and intractable pain.<sup>7</sup> Biphosphonates decrease spinal compression fractures but are less effective after the disease spreads to the bones, and is unsuccessful in preventing intractable pain, decrease in mobility and kyphotic deformities.<sup>8</sup>

Clinical studies regarding vertebroplasty have reported a decrease in pain up to 90% with minor complications, which are relatively unimportant.<sup>9</sup> A study in which vertebroplasty was applied to 14 levels of seven patients, the mean decrease of pain was >50% in six, three patients gave up using analgesics, and the need of analgesic use was diminished in the remaining four.<sup>8</sup> In our series, we detected a mean decrease of 68% in VAS scores of six vertebroplasty patients following the application to 18 levels. All patients had a decrease in analgesic needs.

The major risk of vertebroplasty is extravasation of the cement. The extravasation rate can reach up to 40% in osteoporotic fractures, and this risk can be even higher in osteolytic fractures.<sup>10</sup> Depending on the localization of extravasation, nerve root compression, radiculopathy,<sup>11,12</sup> pulmonary embolization,<sup>13</sup> or cement leakage to the peripheral discal and paravertebral tissues can complicate the procedure. These generally are asymptomatic, and these type of complications can be prevented by precise positioning of the needle.<sup>11,12</sup> Nerve root damage and inflammatory response causing pain can occur because of the high polymerization temperature of the PMMA cement.<sup>14</sup> We did not face any cement extravasation in our series of 34 patients. We think that this comes from our not injecting but impacting the bone cement to the vertebral body. We did not force the cement, just allowed it to settle by itself with small tappings one at a time.

In one study, vertebroplasty was applied to 55 levels of osteolytic myelomatous vertebral bodies, and a mean

of 56% vertebral body height restoration was achieved. In that series, there was a statistically significant improvement regarding vitality, social functions, physical capacity.<sup>6</sup> We calculated our mean vertebral body height restoration as 54% (25–72%).

In our kyphoplasty group, using the VAS scale, we found a decrease of 76% when compared with the preoperative condition and also found a social functional improvement in all patients.

Kyphoplasty and vertebroplasty are both prone to similar complications. In kyphoplasty, cement is put in a preformed cavity, whereas in vertebroplasty cement is pumped into a closed vertebral body. This fact explains why certain complications are less often seen in kypho-

**Figure 3. Patients with <50% compression underwent vertebroplasty**



**Table 4. Analgesic usage (times per week) in both groups**

Analgesic Usage per Week	Kyphoplasty + Vertebroplasty	P Values when Compared to Preoperative Levels
Preoperative	9 (5–14)	
Postoperative 6 weeks	5 (2–9)	P=0.031
Postoperative 6 months	2 (0–5)	P=0.012
Postoperative 1 year	3 (0–7)	P=0.023

plasty.<sup>15</sup> Again, the complications of vertebroplasty can be reduced by impacting the cement instead of injecting it.

Both vertebroplasty and kyphoplasty provide excellent pain relief. In addition, kyphoplasty enhances vertebral biomechanical properties.<sup>16</sup>

We observed that kyphoplasty gave statistically better results in terms of percentage of decrease in VAS scores ( $p < 0.05$ ). The reason of this difference is, in our opinion, due to correction of the biomechanical properties in kyphoplasty (as stated above).<sup>16</sup> It is also important to note that this difference can also be seen because of the preoperative severeness of the pain. Collapsed levels generally create more pain than minimally compressed levels, and the resultant pain relief is higher following vertebral augmentation.

In a patient who has a metastatic disease, the general medical condition is compromised, and general anesthesia carries a high risk. One of the greatest things about these two techniques is that they can be applied under local anesthesia. We operated on all the cases under local anesthesia and conscious sedation, which both saved the patient from general anesthesia and also prevented complications, such as nerve root injury, as we could speak to the patient throughout the operation.

The shortcomings of this study are: 1) the small size of the study group, but this can be compensated by the specificity of the group of patients involved; and 2) the amount of analgesic usage was not compared among the groups.

## CONCLUSION

Even painless vertebrae are possible sites of compression fractures in multiple myeloma, but the application of kyphoplasty or vertebroplasty to those levels is still open to debate.


In pathological vertebral compression fractures, which cause intractable pain and are unresponsive to conservative treatment, both vertebroplasty and kyphoplasty are effective in increasing quality of life and decreasing pain. Using a proper technique, these two procedures can be applied in a nearly complication-free manner. Prospective randomized studies are needed to further evaluate these methods in the treatment of myelomatous vertebral compression fractures.

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