# The Incidence of Recurrent Vertebral Fracture after Kyphoplasty or Vertebroplasty

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**Objective**: The purpose of this study is to identify incidence of recurrent vertebral compression fracture after kyphoplasty and vertebroplasty in patients with osteoporotic vertebral compression fracture. **Methods**: We retrospectively reviewed medical records and radiographic findings including magnetic resonance imaging (MRI) of all consecutive patients who underwent kyphoplasty (21 patients had 26 fractures) and vertebroplasty (29 patients had 35 fractures) at our institution from 2005 to 2007. Recurrent fractures were diagnosed with simple X-rays and MRI. **Results**: Confounding factors of age and bone mineral density (BMD) were considered and found to have no statistically significant difference between no fracture group and recurrent fracture group. Mean cement injection per vertebral body was $4.6\pm1.4$ mL and $4.0\pm1.0$ mL for the kyphoplasty and vertebroplasty groups respectively ($p=0.061$). There were 7 recurrent fractures in patients who underwent percutaneous vertebral augmentation, 4 patients in the kyphoplasty group and 3 patients in the vertebroplasty group respectively. The risk of cement extravasation was 11.5% with kyphoplasty versus 17.1% with vertebroplasty. There were 2 cement extravasations resulting in radiculopathy or myelopathy in the kyphoplasty group. **Conclusion**: The incidence of recurrent fracture after kyphoplasty and vertebroplasty are 15.4% and 8.6% respectively. But the difference in both groups was not statistically significant ($p=0.446$). (J Kor Neurotraumatol Soc 2008;4:84-88)

**KEY WORDS**: Recurrent vertebral fracture · Kyphoplasty · Vertebroplasty.

## Introduction

In the elderly, the acute and chronic pain as well as progressive vertebral collapse are frequently followed after osteoporotic vertebral compression fracture. In the past, vertebral compression fracture has been treated with bed rest, narcotic analgesia, brace, and physical therapy. Recently, two percutaneous vertebral augmentations have been introduced to the treatment of vertebral compression fracture. Vertebroplasty is a percutaneous injection of viscous polymethylmethacrylate (PMMA) into the vertebral body and has been first described by Galibert et al. in 1987.[7] As for kyphoplasty, a balloon is percutaneously inserted into the fractured vertebral body and is inflated to create a cavity.

The balloon is then deflated and removed, and PMMA is injected.

Many reports have shown clinical improvements for patients treated with percutaneous vertebral augmentation. But percutaneous vertebral augmentation must be done with caution because of a number of potential complications. One of the main complications is recurrent compression fracture at non-treated level following augmentation with bone cement. As another complication, the risk of extraosseous cement extravasation can develop during procedure with resultant neurological deficits such radiculopathy and cord compression. We retrospectively analyzed the clinical data of 57 osteoporotic vertebral compression fracture patients and compared the incidence of recurrent vertebral fracture and cement extravasation rate of each procedure.

## Materials and Methods

We conducted the retrospective chart review of all percutaneous vertebral augmentation performed between April 2005 and April 2007. To 50 patients, a total of 61 osteopo-

rotic vertebral compression fractures were treated by vertebroplasty or kyphoplasty. Patients with multiple myeloma and metastatic bone disease were excluded. Mean age of the patients was 73.3 years (range 59－86 years). Of the 50 patients, 29 patients underwent vertebroplasty and 21 kyphoplasty. Mean follow-up period was 11.4 months (range 6－23 months). The fracture site was confirmed by magnetic resonance imaging (MRI) or computerized tomography (CT) with bone scan that was concordant with pain at the site of fracture. All patients had persistent back pain from vertebral compression fractures that were not responsive to medical treatment and had bed rest for 2 weeks.

All patients underwent either single or two level percutaneous vertebral augmentation. The vertebroplasty procedure was performed according to the technique described by Jensen et al.[10] Briefly, fluoroscopic guidance allowed the placement of an 11-gauge bone marrow needle via a bilateral or unilateral transpedicular approach. Intraosseous venography was performed. If the contrast material drained into the venous plexus, the position of the needle was corrected. The PMMA, which was mixed to the consistency of toothpaste, was injected by hand into the vertebral body with the use of 1 cc syringe. And the kyphoplasty procedure was two 11-gauge Jamshidi needles inserted percutaneously and transpedicularly. Two 1.5 mm diameter guide pins were inserted through the Jamshidi needles, then two inflatable bone tamps were inserted into the fractured vertebral bodies. The balloon were dilated under fluoroscopy. Ballooning pressures were not exceed up tp 220 psi, and made balloon cavity in the vertebral body from 2－4 cc per each. Then

PMMA was made and injected through the filler which was 1.5 cc cement was filled. The amount of PMMA injected was 3.0－7.5 cc.

All patients participated in follow-up care via an outpatient clinic at 1 month after operation for evaluation of operative results. When patients complained of back pain after operation, we performed radiologic studies to evaluate the presence of recurrent fracture and other causes of pain. Recurrent fracture was diagnosed using serial follow-up plain radiographs or MRI. In addition, clinical data including pre- and postoperative radiographs, bone mineral density (BMD), cement extravatasion, the amount of cement used, and neurological and systemic complication were reviewed.

Data were analyzed using a commercially available statistical software package (SPSS for window, version 12.0). The t-test was used to analyze age difference, BMD and the amount of cement injected between the two group. The Fisher's exact test was used to analyze the association between either technique and the development of recurrent fracture and cement extravasation. The logistic regression analysis was used to analyze the association between BMD and amount of cement injected and the development of recurrent fracture and cement extravasation. A $p$-value of less than 0.05 was considered statistically significant.

## Results

Fifty patients underwent a total of 61 percutaneous vertebral augmentation procedures. These results are summarized in Table 1. Of these 50 patients treated, 21 patients

**TABLE 1.** Patient data for vertebral augmentation treatment

| No. | Age | Procedure | Op. Levels | Cement amount | Recurrent Fx. level | Cement extravasation | Complication | BMD |
|---|---|---|---|---|---|---|---|---|
| 1 | 65 | Kypho. | L4 | 3.0 | | No | None | −3.1 |
| 2 | 61 | Kypho. | L3 | 7.5 | L4 | No | None | −2.9 |
| 3 | 78 | Kypho. | T12, L1 | 3.0, 6.0 | | Yes | Cord injury | −2.8 |
| 4 | 81 | Kypho. | L3, L4 | 4.5, 5.0 | | No | None | −3.1 |
| 5 | 76 | Kypho. | L2 | 6.0 | | No | None | −3.5 |
| 6 | 69 | Kypho. | T11 | 4.5 | L1 | No | None | −3.8 |
| 7 | 72 | Kypho. | T12 | 4.5 | | No | None | −3.1 |
| 8 | 73 | Kypho. | L1 | 6.0 | | No | None | −3.2 |
| 9 | 79 | Kypho. | L5 | 6.0 | | Yes | Asymptomatic | −3.9 |
| 10 | 65 | Kypho. | L3 | 4.5 | | No | None | −3.6 |
| 11 | 62 | Kypho. | L2 | 4.5 | | No | None | −3 |
| 12 | 78 | Kypho. | T10, T12 | 3.0, 3.0 | L4 | No | None | −3.3 |
| 13 | 59 | Kypho. | L4 | 6.0 | | No | None | −3.1 |
| 14 | 74 | Kypho. | L1 | 4.5 | | No | None | −3.3 |
| 15 | 81 | Kypho. | L2 | 7.5 | L3 | No | None | −2.9 |
| 16 | 75 | Kypho. | L2, L4 | 3.0, 4.5 | | No | None | −3.8 |
| 17 | 82 | Kypho. | T12 | 4.5 | | Yes | Radiculopathy | −3 |

**TABLE 1.** Continued

| No. | Age | Procedure | Op. Levels | Cement amount | Recurrent Fx. level | Cement extravasation | Complication | BMD |
|---|---|---|---|---|---|---|---|---|
| 18 | 66 | Kypho. | L1 | 3.0 | | No | None | −3.7 |
| 19 | 68 | Kypho. | T9 | 6.0 | | No | None | −2.8 |
| 20 | 78 | Kypho. | T10, L2 | 3.0, 3.0 | | No | None | −3.7 |
| 21 | 69 | Kypho. | L2 | 4.5 | | No | None | −3.3 |
| 22 | 77 | Vert. | L1 | 5.0 | | No | None | −3.5 |
| 23 | 80 | Vert. | L2 | 6.0 | L4 | No | None | −2.7 |
| 24 | 84 | Vert. | T10. L3 | 3.0, 4.0 | | No | None | −3.5 |
| 25 | 65 | Vert. | L3 | 4.0 | | Yes | Asymptomatic | −3.2 |
| 26 | 69 | Vert. | L1 | 4.0 | | No | None | −3.1 |
| 27 | 71 | Vert. | T9 | 4.0 | | No | None | −3.2 |
| 28 | 65 | Vert. | L4 | 6.0 | L1 | Yes | Asymptomatic | −3.9 |
| 29 | 74 | Vert. | T12, L2 | 3.0, 5.0 | | No | None | −2.8 |
| 30 | 72 | Vert. | T10 | 3.0 | | No | None | −3.1 |
| 31 | 63 | Vert. | T12 | 4.0 | | Yes | Asymptomatic | −3.5 |
| 32 | 81 | Vert. | L2 | 5.0 | | No | None | −3.8 |
| 33 | 86 | Vert. | T8 | 3.0 | | No | None | −3 |
| 34 | 78 | Vert. | L1 | 3.0 | | No | None | −3.7 |
| 35 | 69 | Vert. | L2 | 4.0 | | No | None | −2.8 |
| 36 | 80 | Vert. | T9, T11 | 3.0, 3.0 | | No | None | −3.1 |
| 37 | 67 | Vert. | L3 | 5.0 | | Yes | Asymptomatic | −3.5 |
| 38 | 78 | Vert. | L2 | 4.0 | | No | None | −3.3 |
| 39 | 73 | Vert. | L1 | 4.5 | | No | None | −3.1 |
| 40 | 71 | Vert. | T9, T12 | 2.0, 4.0 | | No | None | −2.9 |
| 41 | 86 | Vert. | L3 | 5.0 | | Yes | Asymptomatic | −3.8 |
| 42 | 76 | Vert. | L5 | 4.0 | | No | None | −3 |
| 43 | 70 | Vert. | T12, L1 | 2.0, 5.0 | | No | None | −3.7 |
| 44 | 66 | Vert. | L1 | 6.0 | L4 | No | None | −3.2 |
| 45 | 73 | Vert. | T10 | 4.0 | | No | None | −2.8 |
| 46 | 65 | Vert. | L2, L4 | 4.5 | | No | None | −3.1 |
| 47 | 82 | Vert. | L1 | 4.0 | | No | None | −3.5 |
| 48 | 78 | Vert. | L1 | 4.0 | | Yes | Asymptomatic | −3.8 |
| 49 | 73 | Vert. | L3 | 4.0 | | No | None | −3 |
| 50 | 81 | Vert. | T9 | 3.0 | | No | None | −3.1 |

Vert.: vertebroplsty, kypho.: kyphoplasty, BMD: bone mineral density

had 26 fractures treated by kyphoplasty, and 29 patients had 35 fractures treated by vertebroplasty. The mean patient age in the kyphoplasty group was 72 (range, 59−82) and 74 (range, 63−86) in the vertebroplasty group (Table 2). There were no significant differences in age between these two groups ($p>0.05$). A total of 21 thoracic and 40 lumbar augmentation procedures were performed. Thirty nine patients had one treated level, whereas eleven patients had two treated levels at once. Mean cement injection per vertebral body was $4.6\pm1.4$ mL (range, 3.0−7.5 mL) for the kyphoplasty group and $4.0\pm1.0$ mL (range, 2.0−6.0 mL) for the vertebroplasty group. It is not statistically important difference ($p>0.05$) (Table 2). Cement extravasation was seen

in 9 of 61 (14.8%) of the total series {3/26 (11.5%) and 6/35 (17.1%) of the kyphoplasty and vertebroplasty groups respectively} (Table 2). This was not statistically significant ($p>0.05$). But there were two cement extravasation resulting in radiculopathy or myelopathy in kyphoplasty procedure. There was no significant relationship between cement extravasation and the amount of cement ($p>0.05$). Finally, the development of recurrent fractures after vertebral augmentation procedures was analyzed. 4 recurrent fractures seen in patients that underwent a kyphoplasty procedure (4/26, 15.4%) and 3 recurrent fractures seen after vertebroplasty procedures (3/35, 8.6%) (Table 2). All were symptomatic and occurred from 1 month to 12 months after the

**TABLE 2.** Demographics of patient with kyphoplasty compared with vertebroplasty

|  | Kyphoplasty | Vertebroplasty | p value |
|---|---|---|---|
| Age | 72.0±7.1 | 74.2±6.7 | 0.250* |
| Cement volumes (mL) | 4.6±1.4 | 4.0±1.0 | 0.061* |
| Recurrent Fx (%) | 4/26 (15.4%) | 3/35 ( 8.6%) | 0.446** |
| Cement extravasation | 3/26 (11.5%) | 6/35 (17.1%) | 0.720** |

Mean±SD. *p value by t-test, **p value by Fisher's exact test

procedure. But the difference in both groups was not statistically significant (p=0.446). Between recurrent fracture and BMD was not statistically significant (p>0.05). Between recurrent fracture and the amount of cement was not statistically significant (p>0.05).

## Discussion

Percutaneous vertebral augmentation such as vertebroplasty and kyphoplasty is well-established technique that has been reported to provide patients with significant relief and possible correction of deformity with painful osteoporotic vertebral compression fracture.

Although there were good results from percutaneous vertebral augmentation in osteoporotic compression fracture, there were also a number of potential complications. The most common complication associated with augmentation procedure was the extravasation of cement. The risks of cement extravasation in various series range between 3% and 74% with resultant neurological deficits like as radiculopathy and spinal cord injury.[4,10,15-17] In this study, authors report low extravasation rate of 17.1% and 11.5% of vertebroplasty and kyphoplasty respectively. But kyphoplasty has more possibility of symptomatic cement leakage (7.7%). The risk factors related to cement leakage were volumes of bone cement, injection time, injection pressure and limitation of procedure level.[17] But in this study, between cement leakage and volume of bone cement was not statistically significant.

Recently, many articles have proposed high recurrent compression fracture rate after augmentation procedure, possibly ralated to an increase in the stiffness of treated vertebra as "Hammer effect".[1-3] Kim et al.[11] found an increased risk of recurrent fracture adjacent to level with increased height restoration after vetebroplasty.

In a review of similar study by Fribourg et al.[5] 17 additional fractures occurred after 47 levels were treated by kyphoplasty. William et al.[12] reported that their recurrent fracture rate was 15% overall (16 of 109 treated levels) and 10% for 90 days. Majd et al.[14] reported an overall recurrent fracture rate of 10% (36 additional fractures in 360 fractures treated). This study found that the incidence of recurrent fracture is overall 11.5%.

In this study, age had little effect on the incidence of recurrent fracture. Patients with poor BMD would be more likely to sustain recurrent fracture after augmentation procedure.[13] But in this study there was no significant associations between recurrent fracture and BMD. Chun et al.[3] reported little correlation between the amount of injected cement and recurrent fracture. In most articles, the amount of cement was recommended from 3.0 to 6.0 mL. But this study, between recurrent fracture and volume of bone cement was not statistically significant (p>0.05).

To the literature review, the risk of recurrent fracture occurrence appears to be greater in kyphoplasty (45−75%)[5,6,8,14] than vertebroplasty (0−16%).[11,18,19] This study found that an increased rate of recurrent fracture (15.4%) was seen in the kyphoplasty group as compared with the vertebroplasty group (8.6%). The difference in both groups was not statistically significant when Fisher's exact test was applied (p=0.446). This result may be caused by lack of numbers of total patients and recurrent fractures, so in this study it is considered to verify the relationship between those groups conducted throughout much more data.

Through direct comparison of complications developed by kyphoplasty and vertebroplasty, we tried to analyze the risk factor of a procedure and suggest more safe and effective surgical treatment by selecting the percutaneous augmentation for specific patients or improvement of procedures. However, this study was conducted without important factors, such as postoperative activity, body mass index and anti-osteoporotic medication, which have an significant effect on recurrent fracture. These patient factors have been found to have a predictive value on the incidence of recurrent fracture. Additionally, this study is a small retrospective study, and so a large number of the figures resulted in being meaningless for statistical data. Further study needs to be conducted after this study in order to identify risk factors for initial compression fracture and recurrent compression fracture. Recently, several types of bone cement such as coral calcium, hydroxyapatite, etc. have reported.[9] Biomechanical data suggest less adjacent vertebral stresses and possibly a decreased incidence of recurrent fracture. We hope that the development of better materials would limit adjacent vertebral stress and allow for effective treatment of fracture pain and deformity.

## Conclusion

This study indicates that the incidence of recurrent frac-

ture after kyphoplasty and vertebroplasty is 15.4% and 8.6% respectively. The difference in both groups was not statistically significant. Percutaneous agumentation procedure is increasing, as geriatric population is growing. we hope that further studies will facilitate early detection of higher risk factor of having recurrent fracture and extravasation and advanced materials will decreased this complication and allow for more effective treatment of fracture pain and deformity.

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