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Fractures**

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Patients with Osteoporosis on Steroid Medication Tend to Sustain Subsequent Fractures

BACKGROUND AND PURPOSE: Repeat fractures after percutaneous vertebroplasty can be seen in patients with osteoporotic compression fractures. The purpose of this study was to identify characteristics of patients with new fractures after vertebroplasty.

MATERIALS AND METHODS: Fifty-five consecutive patients were treated with vertebroplasty for painful osteoporotic compression fractures at our institution. The charts and radiographic studies of all patients were retrospectively reviewed. Special attention was paid to patient age and sex, imaging studies, long-term use of steroid medication, and treatment for osteoporosis. We used logistic regression analysis and the Fisher exact test for statistical evaluation.

RESULTS: Thirty-five patients were treated with vertebroplasty at one time and did not develop new fractures, whereas 20 patients returned with new fractures. Sixteen of 55 patients had been on steroid medication. The incidence of subsequent vertebral compression fractures after vertebroplasty in patients on long-term steroid therapy was 69% (11/16), compared with 23% (9/39) in those with primary osteoporosis (ie, those who were not on steroid therapy). There was a statistically significant association between use of steroids and new fractures ($P < .01$). No statistically significant difference was noted in patient age, sex, and medication for osteoporosis.

CONCLUSION: Patients who are on long-term steroid medication have an elevated risk of developing new fractures after vertebroplasty.

Percutaneous vertebroplasty is a minimally invasive procedure that provides pain relief and stability for osteoporotic compression fractures.¹⁻¹³ Previous studies have shown significant pain relief in more than 80% of patients.¹⁻⁶ However, previous studies have also shown new fractures after vertebroplasty in 8%–52% of patients, especially in the vertebral bodies adjacent to the treated vertebra.⁷⁻¹³ In our practice, we have often seen patients on steroid medication come back with new, painful fractures. The purpose of this study was to identify the relationship between use of steroid medication and development of new compression fractures after vertebroplasty.

Materials and Methods

Our institutional review board approved this retrospective study and waived the requirement of informed consent. The study was compliant with the regulations of the Health Insurance Portability and Accountability Act.

Patients

This study group consisted of 55 consecutive patients (38 women and 17 men; age range, 45–93 years; mean age, 78 years) who had osteoporotic compression fractures treated with vertebroplasty at our institution. A total of 79 vertebral bodies were treated in these patients initially. Most of the fractured vertebral bodies were located around the thoracolumbar junction. The locations and numbers of the treated and untreated vertebrae are listed in Table 1.

Table 1: Locations and numbers of treated and untreated vertebral compression fractures

Location	Treated	Untreated
T2	0	1
T3	0	0
T4	1	1
T5	2	3
T6	4	1
T7	5	6
T8	5	5
T9	2	6
T10	8	1
T11	8	7
T12	6	6
L1	17	6
L2	8	4
L3	5	6
L4	6	3
L5	2	0
Total	79	56

Vertebroplasty Technique

Vertebroplasty was performed through a transpedicular or parapedicular approach with a 13-gauge bone biopsy needle (Osteo-Site; Cook, Bloomington, Ind) placed into the anterior third of the vertebral body. The procedure was performed under biplane fluoroscopic control with the patient under conscious sedation and local anesthesia on an outpatient basis.

Once the needle was placed in the vertebral body, the liquid and powder polymethylmethacrylate (Cranioplastic; Codman, Raynham, Mass) was mixed with 12 g of barium sulfate (Biotrace; Bryan, Woburn, Mass) to a doughlike consistency. Under biplane fluoroscopic guidance, the cement was injected alternatively through the needle with the use of a 1-mL syringe. The injection continued until the vertebral body was filled toward the posterior 25% of the vertebral body. The patient lay prone on the angiographic table during the injection. After the injection, the patient remained prone on the angiographic table for approximately 20 minutes and was then transferred to a regular bed.

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Fig 1. MR images of vertebrae in a 58-year-old woman with a history of long-term steroid use for treatment of a brain tumor. The patient was treated with multiple sessions of vertebroplasty. A, Initial sagittal T1-weighted image 16 days before treatment shows an acute compression fracture of the L3 vertebral body. B, Sagittal T1-weighted image 7 days after the initial treatment shows a new compression fracture of the L2 vertebral body. Bone cement is noted in the L3 vertebral body (arrow). C, Sagittal T1-weighted image 22 days after the second treatment shows a new compression fracture of the L1 vertebral body. Bone cement is noted in the L3 and L2 vertebral bodies (arrows). D, Sagittal T1-weighted image 27 days after the third treatment shows a new compression fracture of the T11 vertebral body. Bone cement is noted in the L3, L2, and L1 vertebral bodies (arrows). E, Sagittal T1-weighted image 11 days after the fourth treatment shows a new compression fracture of the T10 vertebral body. Bone cement is noted in the L3, L2, L1, and T11 vertebral bodies (arrows).

Table 2: Relationship between use of steroid medication and presence of subsequent fractures (no. of patients)

	Steroid Use	No Steroid Use	Total
Fractures	11	9	20
No fractures	5	30	35
Total	16	39	55

Clinical Data Collection

The charts and radiographic studies of all patients who underwent vertebroplasty at our institution were retrospectively reviewed. Documentation from an outside hospital was included when available. We recorded the patients' age and sex, imaging studies, long-term use of steroid therapy, and treatment for osteoporosis.

Statistical Analysis

We performed statistical analysis with commercially available software (SPSS for Windows, version 11; SPSS, Chicago, Ill). Relevant clinical characteristics were entered into a logistic regression analysis to determine predictors of new fractures. The patients' age at initial treatment, sex, long-term use of steroid medication, and medical treatment for osteoporosis were the independent variables. We used the Fisher exact test to evaluate the relationship between use of steroid medication and the presence and location of subsequent fractures. We also used the Mann-Whitney *U* test to evaluate differences in time intervals for new fractures in patients with and without long-term use of steroid medication. A *P* value < .05 was considered statistically significant.

Results

Thirty-five patients were treated at one time and had no new fractures on follow-up. Twenty patients returned with new fractures, and 17 were treated a second time (Fig 1). Sixteen of 55 patients had been treated with long-term steroid therapy. The reasons for steroid medication were chronic obstructive pulmonary disease (*n* = 9), autoimmune disease (*n* = 6), and primary brain tumor (*n* = 1). Eleven (55%) of 20 patients returned with new fractures and been on long-term steroid

Table 3: Association between variables and refracture (logistic regression analysis)

Variable	Regression Coefficient	SE	Wald Statistic	95% CI
Steroid	1.796	0.791	5.151	1.278–28.421
Treatment for osteoporosis	−0.709	0.701	1.024	0.125–1.943
Age	−0.280	0.034	0.665	0.909–1.040
Male sex	0.175	0.735	0.057	0.282–5.032

Note:—CI indicates confidence interval.

Table 4: Relationship between use of steroid medication and location of subsequent fractures (no. of patients)

Location	Steroid Use	No Steroid Use	Total
Adjacent vertebrae	6	10	16
Remote vertebrae	10	2	12
Total	16	12	28

Note:—Remote vertebrae indicate the fractured vertebrae that had at least 1 nonfractured vertebra between the treated vertebrae.

therapy, whereas only 5 (14%) of 35 patients without a new fracture had used steroids. The incidence of new vertebral fractures after vertebroplasty in patients with steroid-induced osteoporosis was 69% (11/16), compared with 23% (9/39) in patients with primary osteoporosis. Thus, steroid medication was associated with occurrence of new fractures after vertebroplasty (*P* < .01, Table 2). There was no statistically significant association between new fractures and the patients' age, sex, or medication for osteoporosis (*P* > .05, Table 3).

Mean follow-up was 535 days. New fractures were noted in 28 vertebral bodies in 20 patients (Table 4). Sixteen (57%) of these 28 fractures were adjacent to the vertebral bodies that had been treated previously. The other 12 (43%) fractures were remote from the treated vertebral bodies. Adjacent fractures were seen more often in patients who were not on steroid therapy than in those who were (83% vs 38%, *P* < .05). The average time for a new fracture to occur was 78 days after vertebroplasty (range, 8–337 days). The patients who were on long-term steroid therapy tended to return sooner than those who were not (mean times, 50

days and 113 days, respectively), but this difference was not statistically significant in this group ($P = .710$).

Discussion

This retrospective study has shown that patients with steroid-induced (secondary) osteoporosis tend to develop new compression fractures after vertebroplasty more often than patients who are not on steroid therapy. The incidence of new vertebral compression fractures after vertebroplasty was 69% in patients with steroid-induced osteoporosis compared with 23% in patients with primary osteoporosis. To the best of our knowledge, this is the first documentation of the strong association between steroid-induced osteoporosis and new vertebral compression fractures after vertebroplasty. However, for kyphoplasty this association has been documented previously. Harrop et al¹⁴ reported an incidence of new vertebral compression fractures after kyphoplasty in 48.6% of patients with steroid-induced osteoporosis, compared with only 11.25% of patients with primary osteoporosis, concurrent with our results.

It is unknown whether a new fracture after vertebroplasty is the result of the natural history of osteoporosis or the effect of cement augmentation. Lindsay et al¹⁵ reported that if a patient presented with an osteoporotic vertebral fracture, then there was a 19.2% incidence of a subsequent fracture within 1 year. Previous studies have shown new fracture after vertebroplasty in a similar frequency (8%–52%).^{7–13} New fracture after kyphoplasty has also been observed with approximately the same frequency (31%).¹⁶ Most of the new fractures tend to occur during the first few months after the initial procedure.^{7–13,16}

No established rate of subsequent fracture has been documented in patients with secondary osteoporosis. In this study, the patients with steroid-induced osteoporosis tended to have new fractures in remote vertebrae rather than immediately adjacent to the treated vertebrae. Therefore, it is likely that new fractures after vertebroplasty in patients with steroid-induced osteoporosis are due to the natural history of the disease rather than to the vertebroplasty itself. We do not believe that performing vertebroplasty on patients with steroid-induced compression fracture increases their risk of subsequent fractures. We will continue to perform vertebroplasty for these patients to alleviate otherwise intractable pain. This treatment has a substantial effect on pain relief and quality of life and should not be withheld.

In patients with primary osteoporosis, the new fractures were often seen in the vertebra immediately adjacent to the treated one. Therefore, it is possible that the treated vertebral body contributed in some way to the development of the new fracture in the adjacent vertebral body. At this time, this mechanism is not well understood or documented, and further studies are needed to understand the relationship between the effects of treatment and the natural history of vertebral compression fractures in primary osteoporosis.

In this study, the patients with steroid-induced osteoporosis tended to sustain new fractures sooner than the patients with primary osteoporosis (50 vs 113 days). In this small group, we were not able to document this difference statistically.

Glucocorticoids are a well-known cause of secondary osteoporosis.^{17–22} Saag et al²¹ reported that alendronate reduces the risk of vertebral fractures in patients with glucocorticoid-induced osteoporosis. However, osteoporosis is often underdiagnosed and is not treated medically.²³ In this study, we did

not find a statistically significant difference in patient age, sex, and medication for osteoporosis.

We lacked systematic follow-up of the patients, which could be a limitation of this study. No data regarding bone mineral attenuation measurement was available in this study. Further evaluation such as a bone mineral density test for other risk factors should be awaited.

Conclusion

Patients with steroid-induced osteoporosis have a higher incidence of new fractures after vertebroplasty than patients with primary osteoporosis.

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