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## SIMPLE VERTEBROPLASTY WITHOUT IMPLANT FOR TREATMENT OF TRAUMATIC VERTEBRAL COMPRESSION FRACTURES

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### ABSTRACT

Twenty-six (16 men and 10 women) posttraumatic wedged kyphotic spinal fractures treated with PMMA (polymethylmethacrylate) vertebroplasty were reviewed. Those patients with single body lesion varied from T11 to L5 received their operations between January 2001 and May 2004. The surgical procedures were performed at an average of 17 days (ranges: 6 to 58 days) after trauma. 10-point pain score, 4-grade mobility scale and spinal X-rays were used to evaluate clinical assessment and calculate fractured-height restoration. The following results were obtained: Approximately 3mL to 8.5mL (average: 5.6mL) of cement was injected. Substantial immediate pain relief (>5 points) occurred in 98% (25/26) of patients and significantly greater walking strength (>2 grades) was obtained in 92% (24/26) of patients. The average anterior height loss was  $12.3 \pm 2.2$  mm (range: 8-17 mm) in 19-studied cases. The mean body height gain was  $6.7 \pm 1.2$  mm. The anterior/posterior body height ratio were 0.38 ~ 0.76 before procedure and had been corrected up to 0.63 ~ 1.10 after procedure. The percentage of height restored was ranged from 12 to 122% (mean: 55%). The average angle correction of these wedged fractures was 11 degrees. These results had sustained for an average of 23 months' (ranged from 7 to 35 months) follow-up period. Cement leakage occurred in 6 out 26 (23%) cases but they discharged uneventfully. No further subluxation was noted. The mortality rate was 0%. The findings indicate that treatment with a simple PMMA vertebroplasty for traumatic vertebral body fracture is enough. Except dramatic clinical pain relief relief, it is a safe and reliable procedure which can correct traumatic wedged kyphosis to a more physiologic geometric relationship and maintain reliable stability without adding any instrumentation.

**Key words:** PMMA, vertebroplasty, kyphotic vertebral fractures, trauma

### INTRODUCTION

Traditional surgery for T-, L-spine wedged compression fractures such as anterior, posterior or combined implant fixation had been advocated and showed various degrees of success. However, no immediate pain relief and implant failure are two major disadvantages<sup>1-3</sup>. Polymethylmethacrylate (PMMA) vertebroplasty is a new technique used to treat pain, walking disability from osteoporotic vertebral fractures<sup>4</sup>. It coincidentally make attempt to restore height loss and reduce the deformed angle of collapsed body, therefore, has potential to prevent further kyphosis. Twenty-six trauma cases were treated in this study. We aim to point out that through a simple vertebroplasty, the traumatic patients have the same capability as osteoporotic cases in relieving pain, correcting kyphosis and maintaining stability by adding no implant.

### MATERIALS AND METHODS

Twenty-six (16 men and 10 women, age ranged from 38 to 82 years, mean: 51 years) simple traumatic VB compression fractures treated with vertebroplasty and no auxiliary implant were reviewed during the period of January 2001 and May 2004. All patients had single level (T11 to L5) kyphotic wedged body fractures with trauma history ranged from 6 to 58 days. 10-point pain score, 4-grade

mobility scale and plain X-ray were examined to evaluate clinical improvement and to calculate fractured-height and angle restoration. Those patients associated with unstable fracture-dislocation were excluded.

Under general anesthesia, the technique started with a mini skin incision and drawled a guide pin entering the pedicle and created a void inside the fractured body. Then, bilaterally symmetric injection of appropriate amount of PMMA cement (Osteobond, Zimmer, Indiana, U.S.A.) into the void was performed which ended with elevation of the end plates (Fig 1). No further pedicle screws were added.

The pre- and postoperative radiographs were compared to calculate the percentage of body height restored and angle reduced. A 10-point semi-quantitative score value of pain intensity was provided for assessment of pain severity<sup>5</sup>. And a 4-grade semi-quantitative scale was used to evaluate ability of mobility<sup>6</sup>.

The vertical heights of all fractured vertebrae were measured before and after surgery and at the end of follow-up. Vertical height was defined as the distance (end plate to end plate) of the vertebral body on the lateral radiograph. The vertical height of the posterior cortex of the fractured vertebra was

**Table 1.**

**Case Summary**

Patient N	Duration Symptoms (days)	Volume Injection	Level Treated	Clinical Improvement		Pre-Tx Ht (B) mm	Post-Tx Ht (C) mm	Pre-Fx Ht (A) mm	B/A ratio	C/A ratio	% Height Restored = C-B/ A-B ×100%	Angle Corrected (pre - post op)
				Pain Scale (10-1)	Walking Ability (4-0)							
1	9	4.0	T12	-8	-3	21	39	37	0.76	1.10	122%	20°(19+1)
2	6	4.5	L2	-9	-4	24	36	40	0.60	0.90	75%	15°(25-10)
3	11	7.0	L4	-6	-3	15	25	30	0.50	0.83	67%	17°(27-10)
4	18	6.0	L2	-10	-4	11	19	23	0.48	0.83	67%	12°(20-8)
5	21	7.5	L4	-4	-2	18	25	29	0.62	0.86	64%	9°(19-10)
6	11	5.0	L1	-9	-3	21	29	34	0.62	0.85	62%	17°(22-5)
7	29	4.5	L5	-7	-3	17	24	29	0.59	0.83	58%	12°(22-10)
8	15	4.0	T12	-5	-3	22	33	39	0.56	0.85	57%	9°(23-14)
9	7	5.0	L1	-7	-2	24	29	33	0.73	0.88	56%	10°(15-5)
10	22	8.5	L1	-6	-2	22	28	32	0.71	0.88	56%	7°(17-10)
11	58	7.0	L4	-9	-2	20	26	31	0.65	0.84	55%	9°(18-9)
12	17	6.0	L1	-7	-2	15	23	30	0.50	0.77	53%	13°(24-11)
13	10	3.0	L1	-5	-3	22	28	34	0.65	0.82	51%	11°(20-9)
14	9	5.5	T11	-8	-2	10	18	26	0.38	0.69	50%	11°(25-14)
15	12	6.5	T12	-10	-2	23	29	36	0.64	0.81	46%	10°(22-10)
16	13	7.0	L5	-6	-2	19	22	27	0.70	0.81	38%	7°(14-7)
17	14	3.5	L1	-6	-1	16	19	18	0.57	0.68	25%	9°(22-13)
18	16	6.5	T12	-7	-3	14	17	27	0.52	0.63	43%	5°(24-19)
19	18	7.5	L1	-5	-1	25	26	33	0.76	0.79	12%	3°(15-12)

walking without assistance; 1, walking with assistance; 2, wheelchair bound; 3, activity restricted to sitting in bed and 4, bed ridden

also measured as an estimate of the pre-fracture height (A). Anterior height of wedged fractured vertebra was measured as pretreatment fractured height (B). Calculations were made as follows: Height loss was calculated as pre-fracture height (A) - pretreatment fractured height (B) = A - B. Height restored was calculated as post treatment height (C) - pretreatment fractured height (B) = C - B. Pretreatment height ratio was B/A and post-treatment height ratio was C/A. Percentage of height lost that is now restores = (height regained/height lost)×100 = C - B/A - B ×100% (Fig 1)<sup>7</sup>. Degree of kyphotic angle was also measured as the angle between the anterior and posterior cortex of the lesion vertebra<sup>8</sup>.

### RESULTS

The origin of fractures included falling down (13 cases), traffic accident (7 cases), and hitting by material (6 cases). All patients had an average history of 17 days (ranged: 6 to 58 days) before treatment and were contacted for a follow-up period of mean 23 months (range; 7 months to 35 months). Substantial immediate pain relief of an average 7.1

points reduction with a minimum of 5 points occurred in 98% (25/26) of the patients and significantly greater strength was achieved with a minimum of 2 grades in 92% (24/26) of the patients (walking ability improved for an average of 2.5 grades compared to the pretreatment status). The volume of cement injected varied from 3mL to 8.5mL with an average of 5.6mL PMMA was given in this study. Level injected at T11 and L5 in 1 patient, L2 in 2 patients, L4 in 3 patients, T12 in 7 patients and L1 in 9 patients respectively.

Restoration of body height and reduction of post fracture deformity were studied in 19 out of totally 26 thoraco-lumbar or lumbar spines. Restoration of an average of more than 50 % of body height occurred in 74 % (14/19) of the fractures (Table 1, case 1 ~ 14). Spine X-ray showed that the mean anterior height loss was 12.3 ± 2.2 mm (range: 8-17 mm). The mean body height gain was 6.7 ± 1.2 mm after surgery. The anterior/posterior body height ratio were 0.38 ~ 0.76 (B/A) before procedure which had been corrected up to 0.63 ~ 1.10 (C/A) after procedure. The percentage of height

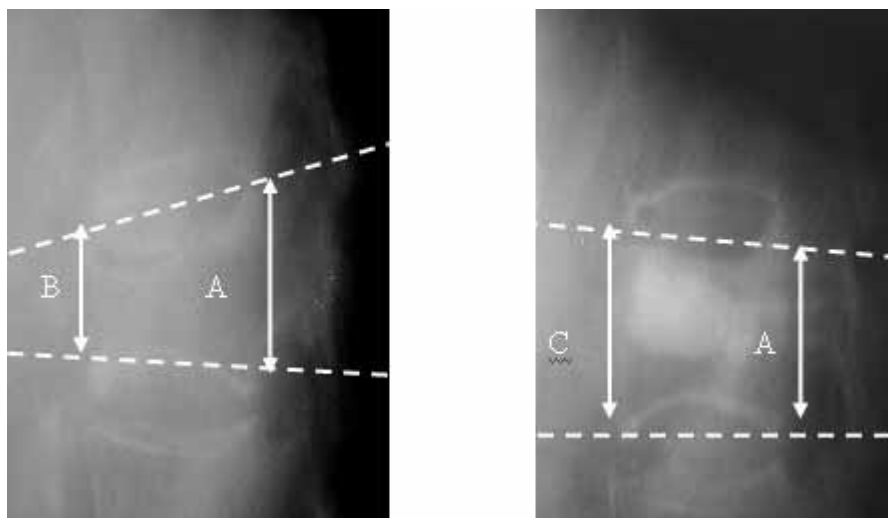


Fig. 1 PMMA vertebroplasty to correct kyphotic wedged deformity 1) Before treatment and 2) after cement injection. A= estimated pre-fractured height. B= pretreatment fractured height. C= post treatment height.  $\theta$ = angle of wedged fracture. % of height restored =  $(C - B)/(A - B) \times 100\%$

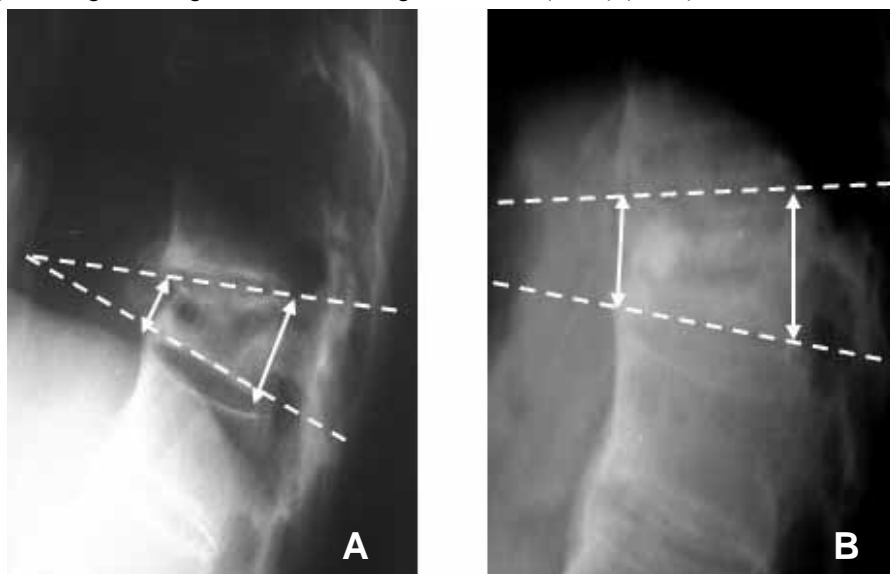


Fig. 2 Case 2

A. Pre- Op: B/A=2.4cm/4cm;  $\theta$  = 25 degrees.

B. Post-Op: C/A=3.6cm/4cm,  $\theta$  = 10 degrees

restoration by the procedure was ranged from 12 to 122 % (mean: 55%) ( Table 1 ). Degree of wedged-fracture angle varied from a maximum of 27 degrees to a minimum of 14 degrees before surgery which had been reduced to a maximum of 19 degrees and a minimum of 0 degree after surgery with an average of 11 degrees improvement in these 19 patients (Table 1). Five cases (case 15 ~ 19) had poor height restoration (less than 50%) after surgery and three had less than 25% (case 17, 25%, case 18, 23% and case 19, 12%) because of cement leakage (Table 1). The total incidence of cement leakage occurred in 6 out of 26 cases (23%) in the study. However, they discharged uneventfully. No further

subluxation or complications were noted during follow-up period. The mortality rate was 0%.

#### DISCUSSIONS

Wedged compression fractures of the thoracolumbar and lumbar spine move the center of gravity anterior and cause posttraumatic kyphosis and further instability. In such cases, restoration of VB height and maintenance of its stability become the most pronounced and desirable effect. Traditional surgical reconstruction with instrumentation may be performed from an anterior or posterior approach; however, because of the inherent risks and invasive nature, the success of these techniques is limited by the patient's poor bone quality as well as technical failure<sup>8</sup>. Eysel et al had mentioned that transpedicu-

lar screw loosening and corrected angle loss were two major defects in these procedures<sup>8</sup>. Aho et al found that post-instrumentation treatment had an average 9.8 degrees correction loss of kyphotic angle and technical late complications, such as loosening of screw was noted in 50% of the patients<sup>2</sup>.

"Vertebroplasty"- a new technique with a number of potential advantages and has been widely used in osteoporotic or metastatic spinal compression fractures<sup>4,7,9,10</sup>. The procedure involves the introduction of a cannular or obturator into the VBs, then creating a void to be filled with bone cement. The polymerization of these PMMA cement expand the vertebral body and can create a "kyphoplasty" effect which fused and recover the fractured VBs back toward its original height and stability. Early in 1995, Krbec et al had already reported bilateral transpedicular cancellous bone grafting to treat traumatic comminuted thoraco-lumbar vertebral fractures<sup>11</sup>. However, a simple PMMA vertebroplasty to stabilize and correct traumatic spinal kyphosis without implant fixation is first reported in the literature. We have found that except satisfactory clinical pain relief and walking ability improvement, this method also provide a simple, reliable way through a single-stage stabilization for these posttraumatic thoraco-lumbar and lumbar vertebral wedged fractures with the additional advantage of re-aligning the spinal column through restoring fractured VB height and prevent further kyphosis in an up to 23 months' follow-up period. The results emphasize the easy performance, dramatic pain relief and immediate stability effect that PMMA vertebroplasty alone can do on the degree of fractured height restoration, and various extent of kyphotic angle reduction.

Today several bone cements or even osteoconductive materials are available for vertebroplasty. PMMA is currently the stabilizing bone filler of choice for its advantage of rapidly expanding the endplate, thermal destruction of painful nerve ending as well as mechanical stabilization of micro fracture through polymerization<sup>12-14</sup>. The principal limitation of vertebroplasty for traumatic fractures is cement extravasations noted in 6 cases (out of 26 cases) of this series. Therefore, cement augmentation should be done with more control into the low-pressure environment of the performed cavity and with more viscous partially cured form in an attempt to reduce the risk of extravasations. Also routine phlebography and tampon packing using Surgicel or Gelform may be aided to detect and repair the broken vertebrae. The filling should stop when resistant pressure is felt. The rates of extravasations are as high as 65% in metastasis and 30% when used to treat osteoporotic fracture<sup>1,15</sup>. Although in the entire group we see satisfactory restoration of fractured VB height, a longer follow-up period may be required to see if these corrections

will be maintained.

In summary, PMMA vertebroplasty without implant fixation can provide sufficient stabilization and pain relief with possibility to improve deformity by allowing safe introduction of PMMA into the traumatic fractured vertebra, fuses and realigns it, therefore, prevents further kyphosis. This simple procedure has the potential benefit to decrease the pulmonary, GI and early morbidity consequences related to these fractures, also will work to protect the vulnerable vertebral levels above or below by minimizing force transfer<sup>7</sup>.

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