



1

2

3

3

:  
 MR  
 :  
 (Kyphoplasty)  
 MR  
 CT  
 45 (T7; 1 , T8; 2 , T10; 2 , T11; 2 , T12; 8 , L1; 15 , L2; 8 , L3;  
 5 , L4; 2 ) MR  
 (vacuum change)  
 T1 , T2, T1  
 :  
 45 29 (64%)  
 11 (24%) 가  
 anterior external vertebral venous plexus 22  
 (p<0.05),  
 가 (p<0.05).  
 :  
 가  
 (percutaneous vertebroplasty) 가 가  
 가 (6-10).  
 가 (1-5). 가  
 (polymethylmethacrylate) 가

<sup>1</sup>  
<sup>2</sup>가  
<sup>3</sup>가

가  
 14). 가 (11 -  
 가 (15 - 18).  
 가 가

polymethylmethacrylate (PMMA) polymer 가 15 CC  
 PMMA monomer 5 CC  
 10 CC 1 CC  
 가 가 가

50%

(19).

가

가

1 가 (19).

Jamshidi needle stylet  
 가

MR

MR

T1 T1 , T2

2001 10 2005 3

(kyphoplasty)

CT

35 45 (T7; 1 , T8; 2 , T10; 2 ,  
 T11; 2 , T12;8 , L1;15 , L2;8 , L3;5 , L4;2 )

5 , 30 52 83 71

DSA (digital subtraction angio - graphy)

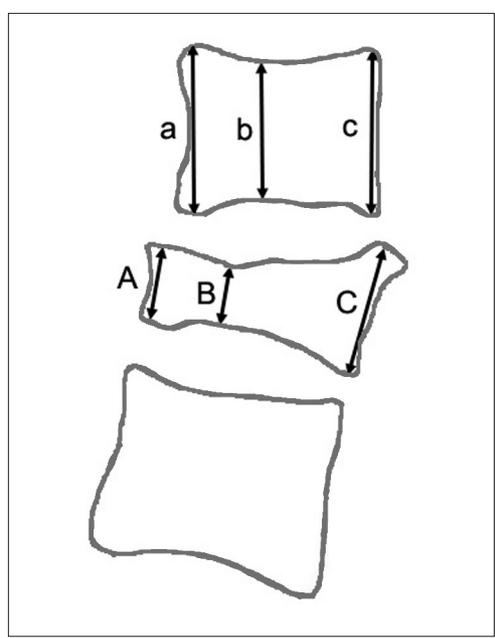
demerol

, Pulse oximeter, EKG

11 12 cm Jamshidi needle

Jamshidi needle

1/3, 1/3



**Fig. 1.** The estimated severity of body compression ( proportion of abnormal to normal vertebral body volumes) was determined as  $( A/a + B/b + C/c)/3$ .

가 3

(Fig. 1). T1  
1/3, 1/3-2/3, 2/3

T2

29 (64%)

45

11 (24%)

CT

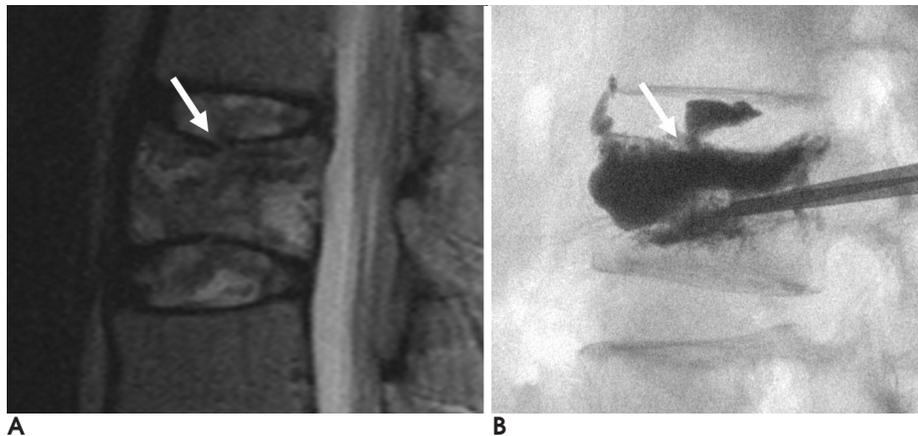
anterior internal vertebral venous plexus, posterior internal venous plexus, basivertebral veins, radicular vein

**Table 1.** The Distribution of Leakage Site

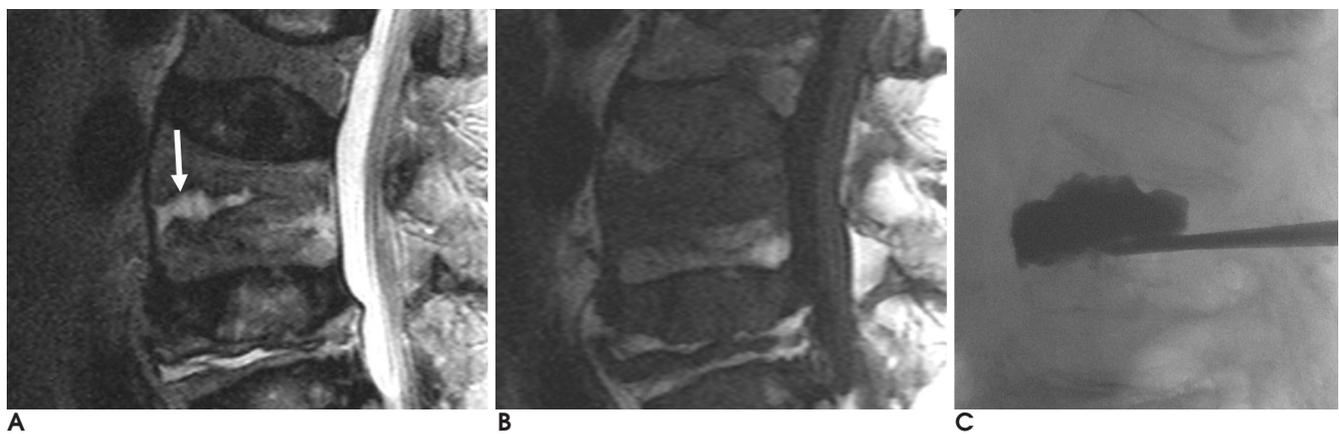
Leakage Site	Number
AEVVP	10
AEVVP, AIVVP	2
AEVVP, Basivertebral vein	4
AEVVP, Disc space	4
AEVVP, Basivertebral vein, Disc space	1
AEVVP, Basivertebral vein, AIVVP	1
Disc space	4
AIVVP, Basivertebral vein	1
AIVVP, Radial vein	1

AEVVP: anterior external venous vertebral venous plexus, AIVVP: anterior internal vertebral venous plexus

SAS(Statistical Analysis System, version 6.12, U.S.A.) P value 0.05



**Fig. 2. A.** T2 weighted sagittal image shows cortical disruption at vertebral upper endplate (white arrow). **B.** After bone cement injection, Fluoroscope image shows the leakage of bone cement at intervertebral space through same site (white arrow).



**Fig. 3. A.** T2 weighted sagittal image shows dark signal intensity line rimmed cystic area (white arrow) in vertebral body. **B.** At T1 weighted image, cystic lesion and surround bone marrow is low signal intensity. **C.** After bone cement injection, Fluoroscope image shows bone cement in vertebral body without leakage.

:

가

가

anterior external vertebral venous plexus

가

22 (Table 1). basivertebral veins

가

7, Disc space 7, anterior internal vertebral venous plexus 3, radial vein 3

2

CC 10 CC 5.1 CC

(23).

79%

가

18

7

(Fig. 2)

MR

가

( $p < 0.05$ ).

(Fig. 3)가

( $p < 0.05$ ).

MR

가

가

T1

, T2 T1

(19)

(vertebral

venous system)

50%

anterior internal vertebral venous plexus, posterior internal venous plexus, basivertebral veins, posterior external vertebral venous plexus, anterior external venous vertebral venous plexus, intervertebral vein, radicular vein, ascending lumbar vein (20).

가

anterior internal vertebral venous plexus, posterior internal venous plexus, radicular vein

가

(21).

peridural membrane

가 (11 - 14, 24, 25).

basivertebral vein

가

가 (15 - 18).

가

(22).

가 가

가 가

(26, 27).

PMMA monomer

(28).

가

가

44 - 113 가  
 39 - 57 (29).  
 (30).  
 kyphoplasty

(31 - 35).

(36, 37).

CT (21).  
 20%  
 2 CC 가 가

(38, 39).

가 가 가 가  
 가 가 가 (26).

가

가

T2

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## MR Predictors of Bone Cement Leakage in Patients Receiving Percutaneous Vertebroplasty<sup>1</sup>

Young Hwan Koh, M.D., Dae Hee Han, M.D., Young Ho Choi, M.D., Joo Hee Cha, M.D.,  
Deuk Soo Jun, M.D.<sup>2</sup>, Wook Jin, M.D.<sup>3</sup>, Hyung Sik Kim, M.D.<sup>3</sup>

<sup>1</sup>Department of Radiology, Boramae Hospital

<sup>2</sup>Department of Orthopedic surgery, Gachon Medical School

<sup>3</sup>Department of Radiology, Gachon Medical School

**Purpose:** To identify MR predictors of bone cement leakage in patients receiving percutaneous vertebroplasty.

**Materials and Methods:** Percutaneous vertebroplasties were performed in 45 vertebrae (T7; one, T8; two, T10; two, T11; two, T12; eight, L1; fifteen, L2; eight, L3; five, L4; two) in 35 patients (age 52 - 83). The procedure was performed using an 11 G Jamshidi needle, which was inserted into the target by the bipedicular approach. Kyphoplasty, unilateral pedicular approach and extrapedicular approach cases were excluded. Shortly after the procedure, all patients underwent a noncontrast CT covering the vertebroplasty sites. A retrospective study was performed to determine whether cement leakage is related to any of following MR findings: presence of cortical disruption of the vertebral body, severity of body compression (proportion of abnormal to normal vertebral body volumes), bone cement amount, bone cement amount/severity of body compression ratio, proportion of low-signal area in a vertebral body on T1 weighted image, presence of either vacuum or cystic portion below a linear dark signal in a fractured vertebra, and the location of dark signal intensity line in a vertebral body. Logistic discrimination model stepwise method was used in the statistical analysis.

**Results:** On post-vertebroplasty CT scan, bone cement leakage was detected in or around 29 vertebrae (64%), including 11 vertebrae (24%) where leakage was found in the epidural space or radial vein. No patients displayed any neurological symptoms or signs. The most frequent site of bone cement leakage was the anterior external vertebral venous plexus (49%). Endplate cortical bone disruption was related to an increased risk of intervertebral bone cement leakage ( $p < 0.05$ ). Bone cement leakage tended to occur less frequently when there is a vacuum or cystic change below the dark linear signal intensity in a fractured vertebra ( $p < 0.05$ ). No other MR findings showed a statistically significant correlation with bone cement leakage.

**Conclusion:** On pre-vertebroplasty MR imaging, vertebral endplate cortical bone disruption and vacuum or cystic change below dark linear signal intensity in fractured vertebra showed a significant correlation with bone cement leakage.

**Index words :** Spinal interventional procedures  
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Bone cements  
Osteoporosis, spinal fractures

Address reprint requests to : Deuk Soo Jun, M.D., Department of Orthopedic surgery Gil Medical Center Gachon Medical School  
1198 Kuweol-dong Namdong-ku Incheon City 405-760, Korea.  
Tel. 82-32-460-3413 Fax. 82-32-460-3064