

# **Clinical importance of posterior vertebral height loss on plain radiography when conservatively treating osteoporotic vertebral fractures**

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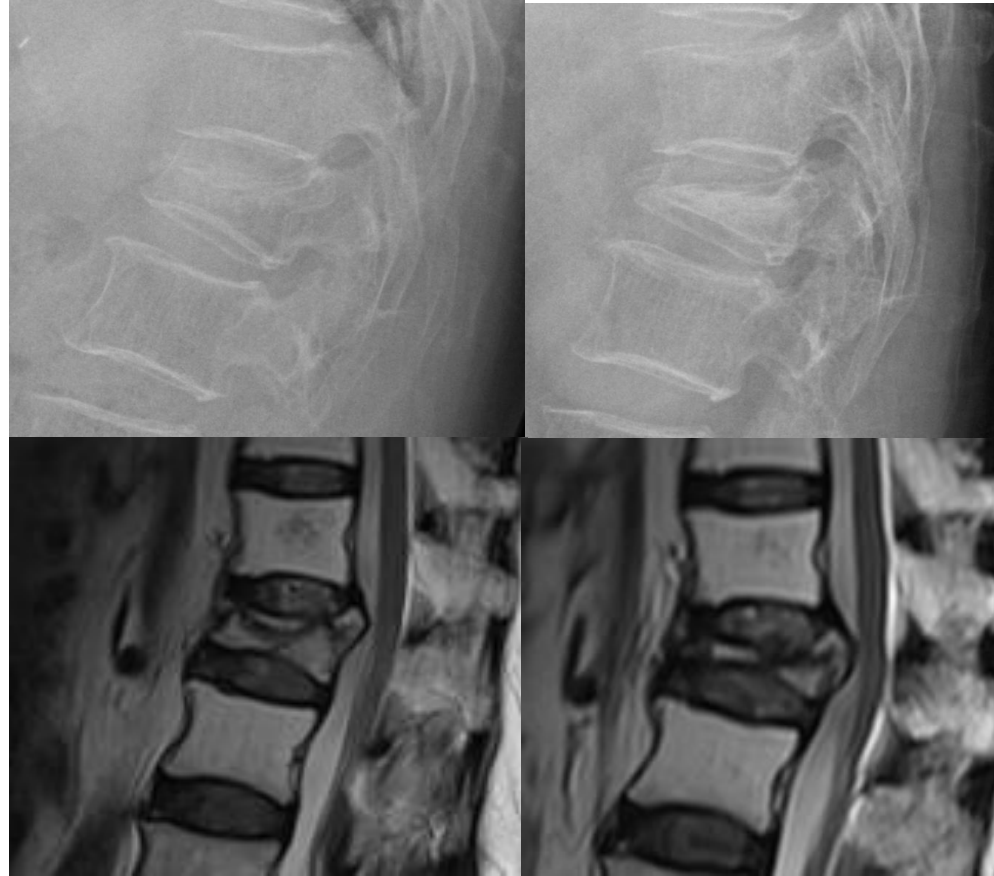
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# PURPOSE

To predict spinal canal compromise, the assessment of plain radiography with magnetic resonance imaging (MRI) can aid the detection of vertebral body collapse



# MATERIALS AND METHODS

- Retrospective cohort study
- From June 2010 to December 2014
- Osteoporotic vertebral fractures (OVFs)
  - > 65 year-old
  - by minor trauma ( ground-level falling or weight-lifting )

## ***Treatment protocol***

- Patients education
  - natural course of vertebral fractures
  - possible complications: delayed neurological deterioration, progressive kyphosis, non-union
- Orthoses for 12 weeks
- Severe pain, difficulty in walk after 3 wks of conservative Tx.
  - Cement augmentation recommended

# MATERIALS AND METHODS

## INCLUSION CRITERIA

- 1) Osteoporosis diagnosed by DXA T-score less than -2.5 on hip and/or spine
- 2) AOSpine thoracolumbar spine injury classification system (AOSTLIC) type A1, 2, 3, and 4
- 3) One-level fracture in the thoracolumbar spine without a previous healed fracture on the adjacent cephalad or caudal level; and
- 4) More than 1 year of follow-up

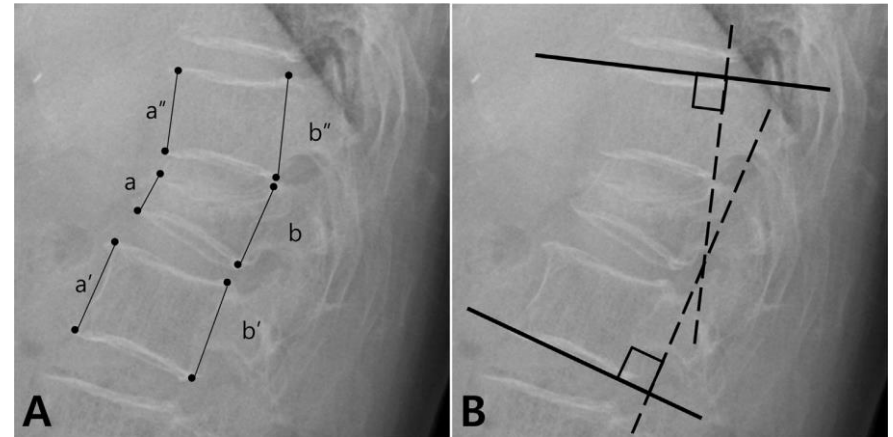
## EXCLUSION CRITERIA

- 1) Pathological vertebral fractures caused by metastasis or infection
- 2) Adjacent two-level or more than two level of concomitant thoracolumbar vertebral fractures
- 3) Thoracolumbar injury classification and severity score (TLICS) of more than 4 points
- 4) AOSTLIC type A0, B and C; and
- 5) Patients who received vertebroplasty or kyphoplasty.

# MATERIALS AND METHODS

## RADIOLOGICAL ASSESSMENT

- Anterior height loss (AHL)  
$$\{[(a'+a'')/2-a]/[(a'+a'')/2]\} \times 100$$
- Posterior height loss (PHL)  
$$\{[(b'+b'')/2-b]/[(b'+b'')/2]\} \times 100$$
- Kyphotic angle (KA, Fig B)
- Fracture morphology
  - AOSpine thoracolumbar spine injury classification system (AOSTLIC, Table)



### Fracture description

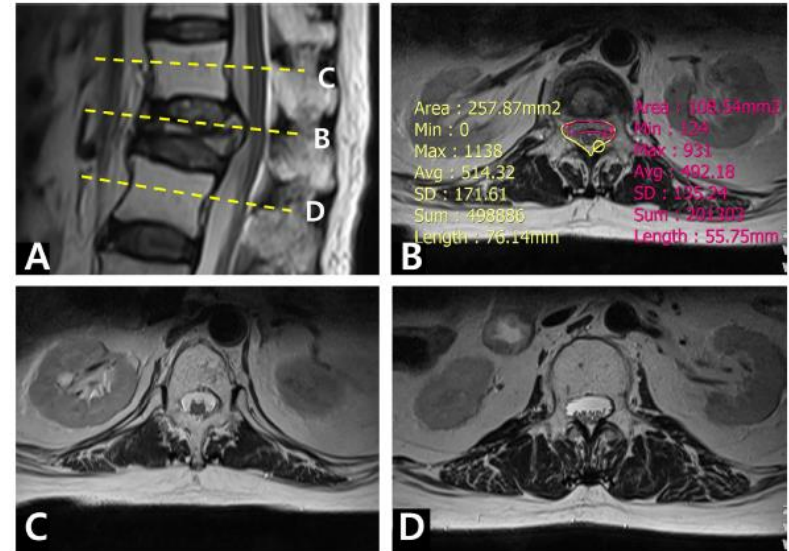
Type A	Compression
A0	No injury/process fracture
A1	Wedge/impaction
A2	Split/pincer type
A3	Incomplete burst
A4	Complete burst
Type B	Tension band injuries
B1	Mono-segmental bony posterior tension band injury
B2	Posterior ligamentous disruption
B3	Hyperextension injury
Type C	Displacement/translational injury

# MATERIALS AND METHODS

## MRI Evaluation

### Canal Encroachment (CE)

CE was calculated as the ratio of the region of interest (ROI) of the posteriorly protruding bony fragment to the estimated original ROI of the spinal canal at the involved level



### Fracture pattern

T1-weighted MRI (T1WI)

confined low intensity, diffuse low intensity

T2-weighted MRI (T2WI)

confined high intensity, diffuse high intensity

confined low intensity, diffuse low intensity

# RESULTS

## Participants

M:F = 15 : 82

Age:  $70.3 \pm 14.6$  years (56 ~ 83)

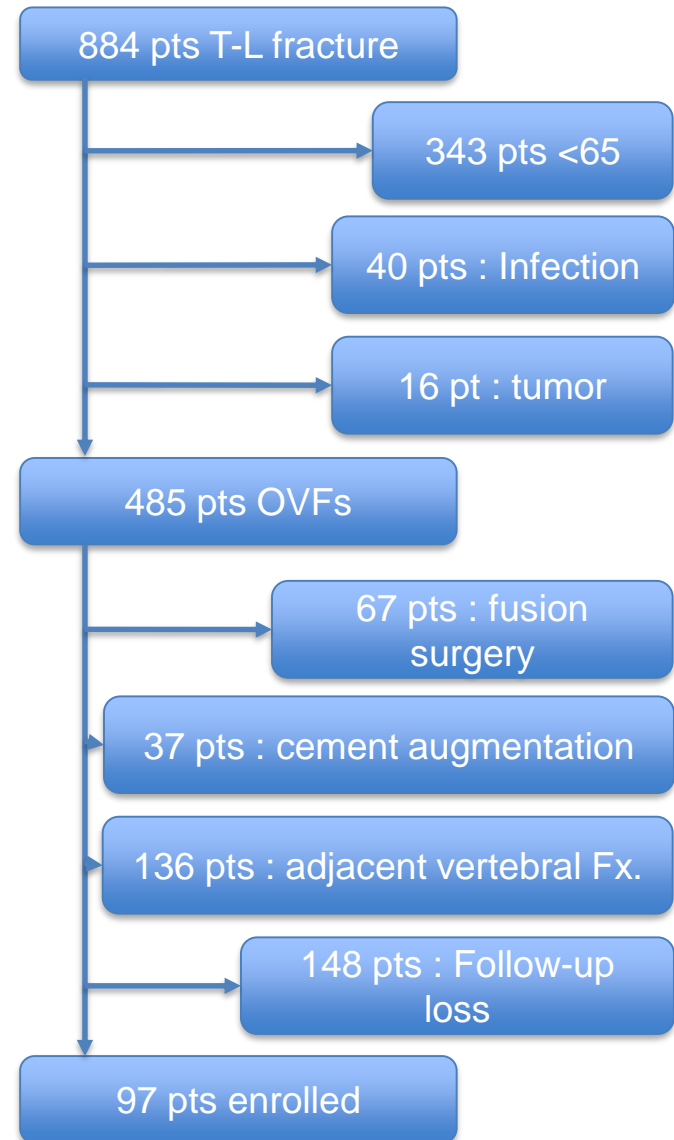
## Fracture Level

T10 (2), T11 (3), T12 (31),

L1 (49), L2 (7), L3 (3), L4 (2)

## BMD T-score

- L-spine :  $-2.95 \pm 1.03$  (-4.5 ~ -0.9)
- Hip :  $-2.66 \pm 1.1$  (-3.3 ~ -1.2).



# RESULTS

## AHL and PHL decreased significantly from the initial to the last follow-up

- The mean  $\Delta\text{AHL}_{(\text{initial-last})}$  was  $22.2 \pm 20.5\%$ .
- The mean  $\Delta\text{PHL}_{(\text{initial-last})}$  was  $12.6 \pm 13.0\%$ .

## Follow-up MRI or CT (38 pt), The mean duration: $66.2 \pm 62.7$ days

- The mean initial CE :  $23.4 \pm 14.5\%$  (n =38).
- The mean follow-up CE :  $38.9 \pm 17.5\%$  (n=38)

Radiological measurements	Initial	Last	p-value
AHL (%), n = 97	28.2 (16.9)	50.6 (20.0)	0.001
PHL (%), n = 97	12.9 (11.2)	20.2 (13.3)	0.001
KA ( °), n = 97	13.8 (5.2)	18.3 (5.8)	0.001
CE (%), n = 38	23.4 (14.5)	38.9 (17.5)	0.018

Described as mean (standard deviation).

AHL: Anterior height loss, PHL: Posterior height loss, KA:Kyphotic angle, CE: Canal encroachment



# RESULTS

## ***Posterior height loss correlates with spinal canal encroachment***

- Initial CE was correlated with the initial PHL ( $r= 0.501, p=0.002$ )
- Initial CE was correlated with the initial AHL ( $r=0.396, p=0.018$ )
- The follow-up CE was correlated with age ( $r=0.481, p=0.003$ ),
- The follow-up CE was correlated with the initial PHL ( $r=0.413, p=0.01$ )
- The follow-up CE was correlated with  $\Delta\text{PHL}_{(\text{initial-last})}$  ( $r=0.685, p<0.001$ )

# RESULTS

## *Diffuse low signal on T1-weighted MRI was correlated with posterior vertebral height loss*

- Table shows radiological variables and initial T1-weighted MRI findings

Variables	Initial MR T1WI findings		p-value
	Confined low	Diffuse low	
No. of patients	34	63	
Sex(M/F)	10/24	19/44	0.67
Age	60.08 (12.19)	69.14 (11.48)	0.04
Initial AHL (%)	24.45 (22.14)	30.01 (17.92)	0.45
Initial PHL (%)	9.5 (6.41)	14.33 (9.12)	0.08
Initial KA (°)	14.26 (3.81)	14.72 (5.94)	0.78
Initial CE (%)	16.11 (6.18)	21.45 (15.28)	0.17
Last AHL (%)	40.95 (20.97)	55.74 (17.73)	0.46
Last PHL (%)	11.37 (10.83)	25.35 (12.20)	<b>0.002</b>
Last KA (°)	17.91 (5.96)	18.25 (5.69)	0.87
Last CE* (%)	n=5 8.45 (7.24)	n=33 31.89 (17.46)	<b>0.004</b>
$\Delta$ AHL <sub>(initial-last)</sub> (%)	17.51 (16.18)	28.28 (18.26)	0.08
$\Delta$ PHL <sub>(initial-last)</sub> (%)	5.66 (4.58)	16.82 (15.04)	<b>0.01</b>

# RESULTS

## ***AOSTLIC type A4 has a greater tendency of posterior wall collapse than A3***

- The fracture morphology was classified as type A1 (n=3), A2 (n=3), A3 (n=58) and A4 (n=33).
- The mean  $\Delta\text{PHL}_{(\text{initial-last})}$  in AOSTLIC type A3 is  $7.67 \pm 7.73\text{mm}$  and that of A4 is  $20.92 \pm 16.04\text{ mm}$ .
- There is statistically significant difference between type A3 and A4. ( $p=0.002$ )
- All of 4 patients with neurological deficit belong to type A4.

## ***Delayed neurological deficits ( 4 pts, Table)***

Pt .	Age	Gender	Fracture level	T1WI	T2WI	Initial AHL (%)	Initial PHL (%)	Initial KA (°)	Initial CE (%)	Last AHL (%)	Last PHL (%)	Last KA (°)	Last CE (%)	TIME POINT OF NEUROLOGIC DEFICIT	TREATMENT
1	69	F	L1	Diffuse low	Confined low	48.10	17.40	18.20	35.10	72.70	33.90	22.30	66.80	6 weeks	Posterior decompression Cement augmentation P/I, PLF
2	80	M	L2	Diffuse low	Diffuse low	2.00	0.00	5.90	0.00	60.00	24.00	8.60	57.80	12 weeks	Corpectomy AIF P/I
3	67	M	L1	Diffuse low	Diffuse low	72.00	21.10	21.70	42.30	72.34	26.40	24.20	50.60	10 days	Corpectomy AIF A/I
4	55	F	L1	Diffuse low	Diffuse low	53.00	17.60	14.20	60.60	68.00	23.10	18.40	67.50	6 weeks	Corpectomy AIF A/I

# CONCLUSIONS

1. In cases with stable spinal fractures, posterior height should be carefully monitored until a solid union is achieved.
2. When the posterior height of the fractured vertebra decreases, doctors should recommend delayed ambulation on the patients.
3. CT or MRI follow-up was also recommended to the patients to evaluate the changed status of the spinal canal.

## **Disclosure declaration**

- None of the authors has any potential conflict of interest