

## Image Study of the Thoracolumbar Spine Fracture

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### – Abstract –

An accurate assessment of injuries to the spinal column and the neural tissues will facilitate the management of patients with injuries to the thoracic and lumbar spine. Routine radiological investigations are essential, but newer techniques are now available that define the extent of injuries in exquisite detail, providing a better understanding of not only the bony injuries, but also the extent of the soft tissue lesion, including the nervous system. The referring physician and the radiologist have many imaging techniques available for the diagnosis of the extent of thoracolumbar spine fracture. These include plain film radiography, computed tomography(CT), conventional polydirectional tomography, bone scan, magnetic resonance image(MRI), and myelography. These techniques are used alone or in combination to arrive at the correct diagnosis. It behooves the examining physician to be extremely thorough in identifying additional lesion, not only for medicolegal reasons, but also to ensure that other potentially unstable lesions are not overlooked, since this could lead to neurological compromise if unsuspected. We describe the integrated use of multiple imaging techniques.

**Key Words :** Thoracolumbar spine fracture, Image

가  
가  
가  
가 (myelography)  
Tomography, CT) 가  
가  
CT CT-myel- 1.  
(Magnetic Resonance Image, MRI) CT

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14 × 17 inch

3~9%<sup>33)</sup>

(multi-level

noncontiguous vertebral fracture)

가

2.

가

가

가 , 가 , 가 가 .

가 swimmer's view .

(instability) (cortical margin), - (spinolami-

dynamic view가 nar line), (Fig. 1)

(interpedicular distance), ,



**Fig. 1.** Wide gap between spinous processes in the AP(flexion-distraction)(A) and lateral(dislocation)(B) views that means posterior column injury.

(double spinous process sign)<sup>48)</sup>

가<sup>22)</sup>

50% 20

(cleft) 가

가<sup>11)</sup>, Daffner<sup>15)</sup>

(posterior vertebral body line, PVBL)

3.

(posterior superior vertebral angle, PSVA)<sup>6)</sup>

가

가

100.

<sup>11)</sup> (Posterior inferior vertebral angle, PIVA) 가 1.3

가

가

가

Chance injury 48%

<sup>43)</sup>

2/3

가

vacuum phenomenon)<sup>25)</sup>

(intravertebral

4. SCIWORA

Kummel

(Spinal Cord Injury without Radiological Abnormality, SCIWORA) 1982

Pang Wilberger<sup>39)</sup>

SCIWORA

가

가

(naked facet)

<sup>24,31)</sup>

SCIWORA

가가

가

5.

(mediastinal widening),

(indirect signs of thoracic fracture)<sup>18,19)</sup>

가

(main stem bronchus)

(depression), nasogastric tube

aortic knob<sup>32)</sup>

dynamic contrast CT aortography 가<sup>22)</sup>

(psoas shadow)

가<sup>41)</sup>

가

6.

28)

(Radionuclide scan)<sup>12)</sup>

## 1) Developmental or congenital conditions

failure of union of the apophysis : spinous, transverse, articular processes

가

apophyseal ring of vertebral body

normal step defect in the juvenile spine

coronal cleft in neonate

SPECT

가

second or third sacral segment in the children

spinal bifida

가

unilateral sacralization of the fifth lumbar vertebra

wide posterior aspect of the S1-S2 interspace

가가

accessory sacroiliac joint

epitransverse process, ptotic transverse process

normal wedging of the vertebral body

residual venous sinus groove

가

24

## 2) superimposition

3~4

가가

thoracic spine with glenoid process of the scapula

8~12

transverse process with psoas muscle

가

1

bony structure in the opposite side of the spine

90%

## 3) Other

2

limbus vertebra

가

가

가

(Tomography)

(CT)

(Computed Tomography)

CT

가

1970

CT

가

MRI

artifacts가

1978

Nykamp<sup>37)</sup>

가

(Myelography)

1920

CT

가

CT

CT-myelography

## 1. Scoutview

scout

3.

scout

33) Takada 46)

scoutview

(disruption) 'rim sign' 가

2. (reconstruction image) 27)

(sagittal reconstruction view) (Fig. 2).

percent canal compromise

(axial image) slice

thickness

CT

('jigsaw puzzle' sign)(Fig. 4), 13)

가 20) 가

slice thickness가

volume averaging effect 가 . Saifuddin 42) 가

17,23)(Fig. 3)

single central fragment, sagittal split through the middle of the fragment, comminution of the fragment, asymmetrical fragment single central fragment 가 가 2).

. Kosling 30) 3

(3D CT surface reconstruction)

Domenicucci

(Fig. 5).

ci 17)

subtraction technique McAfee

(vertebral column)

가



**Fig. 2.** Sagittal reconstruction view is useful in the evaluation of the canal encroachment, preoperatively(A) and canal clearance post-operatively(B).

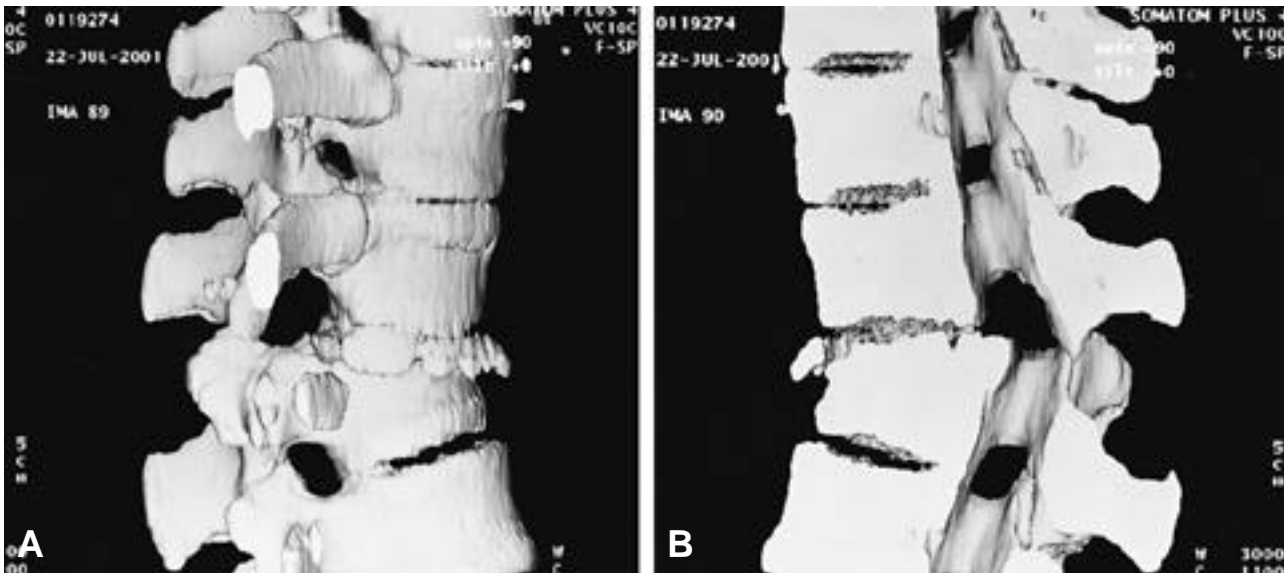


Fig. 3. 3D reconstruction view is useful only in the malalignment(A) but subtraction technique can demonstrate canal encroachment(B).

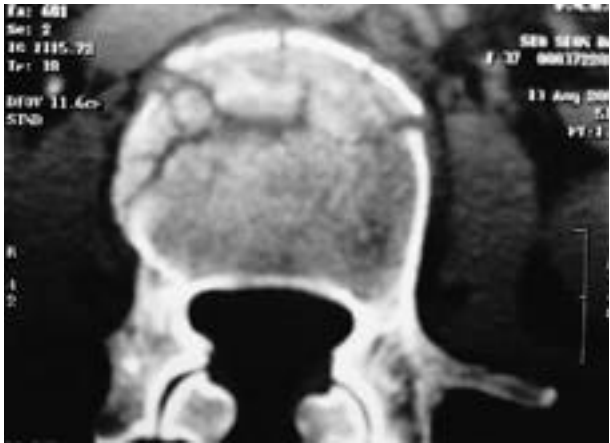


Fig. 4. 'Jigsaw puzzle' sign in compression fracture.

(double body sign, double vertebra)<sup>35)</sup> -  
(shear injury)  
CT slice 가  
가 empty(naked) facet sign<sup>38)</sup>  
(Fig. 6).  
가  
가  
44)  
CT-myelography MRI가  
,  
(posttraumatic cystic myelopathy)  
. Denis Burkus<sup>16)</sup>  
CT criteria  
,  
(tethering)  
7~16%  
, 74%  
가  
(impingement)  
36)  
(central split fracture)  
29,45) Cammisa 9)  
100%  
10)  
50%

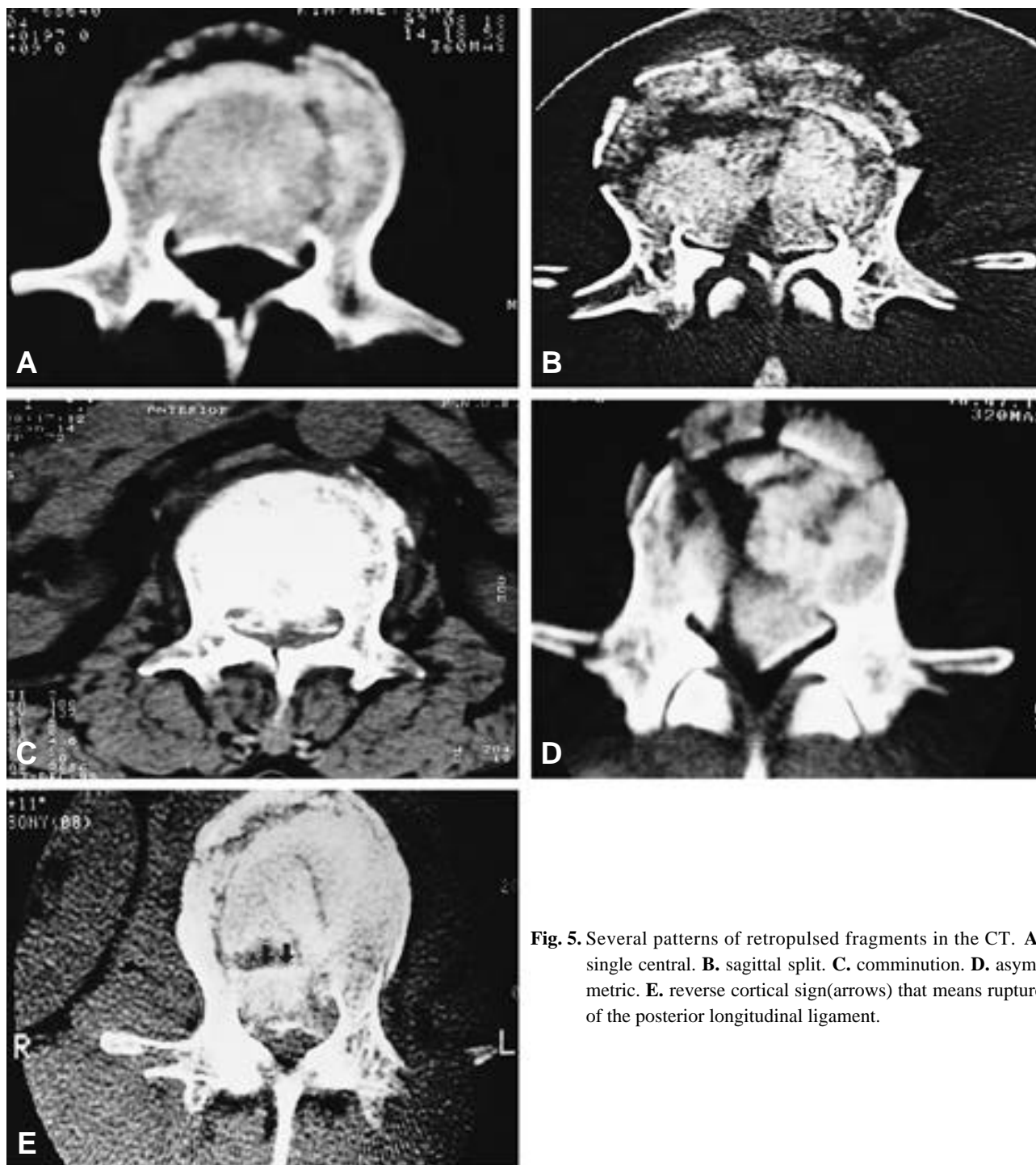
180 °

reverse cortical sign

가

(Magnetic resonance imaging, MRI)

MRI



**Fig. 5.** Several patterns of retropulsed fragments in the CT. **A.** single central. **B.** sagittal split. **C.** comminution. **D.** asymmetric. **E.** reverse cortical sign(arrows) that means rupture of the posterior longitudinal ligament.

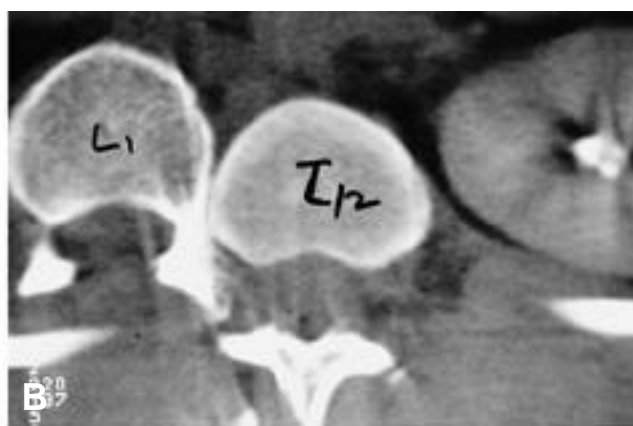


Fig. 6. Empty facet sign(A) and double body sign.

.  
 ,  
 . T1  
 ,  
 . T2  
 ,  
 .  
 .  
 MRI 가 47). MRI  
 sequence spin-echo  
 gradient-echo T2 spin-echo T2  
 . MRI 5 가  
 . (1) vertebral fracture, subluxation, and  
 compressive injury, (2) ligamentous injury, (3) disk injury  
 and herniation, (4) epidural and paravertebral hematoma,  
 and (5) spinal cord edema and hemorrhage 22).

1.

MRI CT  
 .  
 T1  
 가 가 (Fig.

7). Short tau inversion recovery(STIR)

가 . T2 가 가 CT  
 . T1, T2 가

T1 isointense, T2  
 .  
 MRI (middle column) (posterior col-  
 umn)  
 가 .

1) MR differentiation of pathologic and osteoporotic com-  
 pression fractures

MRI  
 가  
 .  
 T1  
 가  
 .  
 1)  
 , T1  
 , Gd

가  
 T2 가  
 .  
 6 MRI

5). CT



MRI

2. <sup>8)</sup>

1) (ALL) (PLL) 2)

MRI

가

proton density

proton density

가

T1 (posterior ligament complex)

T2

CT

<sup>34)</sup> fat-suppressed T2

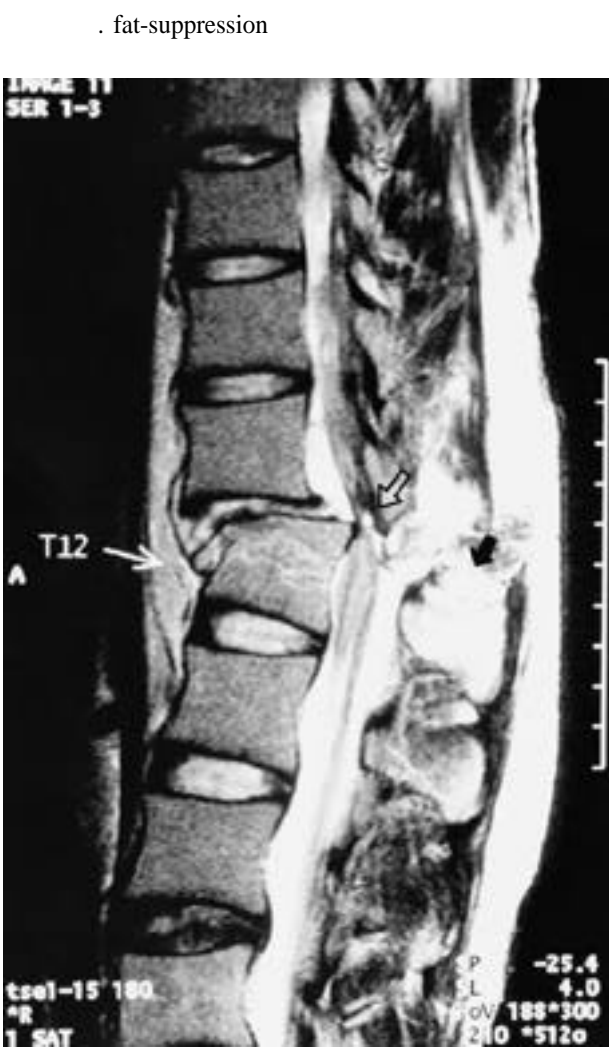
가

T2 MRI

(Fig. 8)



**Fig. 7.** Multiple stage of the fracture healing in MR.



**Fig. 8.** MR is superior to any other imaging modalities in evaluation of the posterior ligament complex injury(black arrow). And also is the only method of direct visualization of the nerve injury(white arrow).

, fat-suppressed T2			가		
34)			3 T2		
47)			가		
20	가, 2 mm	,	sion)	(Table 1).	(contu-
가	14)		Bondurant	21	1
			Frankel		
3. Traumatic disc injury			2 3		
			, T2		
			가		
			6.		
			MRI		
MRI			MRI		
			CT		
4. Epidural Hemorrhage			가		
MRI			가		
			가 가		
			Gd		
			가가		
			T1		
			, 24		
			가가		
			T1		
			, T2		
			. 36		
			가		
			T1		
			가가		
2-4			T2		
가			5		
			articular mass		
			가		
			가		
5. Spinal cord injury			가		
MRI			wedging		
(Fig. 8).					
SCIWORA			가		
MRI					
13) MRI					
가			40)		
Kulkarni 33)			MRI		
			1 T2		
			가		
2 T2			가		
			가		

**Table 1.** MR signal changes in vertebral trauma

	T1 weighting	T2 weighting
Cord edema	Low	Increased
Cord hemorrhage		
Acute(<24 h)	Isointense	Low
Subacute(24 h~3 wk)	Increased	Increased
Chronic(>3 wk)	Low	Increased
Epidural hematoma		
Acute	Isointense	Low
Subacute	Increased	Increased
Myelomalacia	Low	Increased

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