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– Abstract –

Reliability of MRI to Detect Posterior Ligament Complex Injury in Thoracolumbar Spinal Fractures

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Study design : Prospective study of 34 patients with thoracolumbar spinal fractures.

Objectives : To assess the reliability of MRI in detecting posterior ligament complex(PLC) injury in thoracolumbar spinal fractures.

Summary of Literature Review : Some researchers have studied PLC injury in spinal fracture using MRI. However, most of them did not evaluate the findings of MRI compared to the operative findings.

Materials and Methods : Thirty-four patients with thoracolumbar spinal fracture were evaluated by palpating the interspinous gap, plain radiography and MRI before operation. These findings were compared with operative findings. In addition to conventional MRI sequences, a fat-suppressed T2-weighted sagittal sequence was performed. Operation was performed by posterior approach. During the operation, we carefully examined the PLC injury.

Results : Wide interspinous gap was palpated in 14 patients and was found in 21 patients on plain radiography. PLC injury was suspected in 30 patients on MRI. Injury to supraspinous ligament(SSL) was suspected in 27 patients; interspinous ligament(ISL) in 30 patients; and ligamentum flavum(LF) in 9 patients on MRI. There were 28 SSL injuries, 29 ISL injuries, and 7 LF injuries on operative findings. There was a significant relation between the MRI and operative findings.

Conclusions : A fat-suppressed T2-weighted sagittal sequence of MRI was a highly sensitive, specific, and accurate method of evaluating PLC injury. Based on the results of this study, a fat-suppressed T2-weighted sagittal sequence of MRI is recommended for the accurate evaluation of PLC injury and would be helpful in the selection of treatment options.

Key Words : Thoracolumbar spinal fracture, Posterior ligament complex, Fat-suppressed T2-weighted sequence, MRI

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17 . 12 가 10 , 1 가
가 .

T2 (fat-suppressed T2-weight-
ed sagittal image)

가 .

30,33}

4-6,21,22,24,27)

20%

T2

3,12,14,18,29,31,32)

가 .

(supraspinous ligament), (interspinous liga-
ment), (ligamentum flavum),
(capsule of facet), (anulus fibrosis),

(posterior ligament complex)

T2

test Fisher's exact test

Chi-square

7,15-18,20,25)

가 .

T2

(fat suppressed sequence)

가

1,14,19,26,28,36)

14

가 .

2 ,

4 ,

6 , -

17 , -

5

가

4~5 가 1 , 9~10 가 1 ,

11 가 1 , 11~12 가 1 , 12 가 9

, 1 가 16 , 1~2 가 1 , 2

가 2 , 3 가 1 , 5 가 1 .

가 21

T2

가 27 ,

34

가 30 ,

가 9

24 10
34.9(13~67)

28 ,

29 ,

8 ,

5 ,

18 ,
3

7

Table 1. Accuracy of palpation, plain radiography and MRI in detecting PLC injury

	Sensitivity (%)	Specificity (%)	Positive PV (%)	Negative PV (%)	Accuracy (%)
Palpation	52.0	66.7	92.9	14.3	53.6
Plain radiography	66.7	66.7	95.2	16.7	66.7
MRI					
SSL	92.9	80.0	96.3	67.6	90.9
ISL	100	75.0	96.7	100	97.0
LF	85.7	88.5	66.7	95.8	87.9

PLC = posterior ligament complex; PV = predictive value; SSL = supraspinous ligament
 ISL = interspinous ligament; LF = ligamentum flavum

(Chi-square = 0.373, P = 1.000).

가 67.6%, 90.9% .

100%, 75.0%, 96.7%,
 100%, 97.0% .

(Chi-square = 1.310, P = 0.538).

2 (2/2, 85.7%, 88.5%, 66.7%,
 100%), 7 (7/10, 70%), 14 - 95.8%, 87.9% (Table 1).
 (14/17, 82.3%), 5 - (5/5,
 100%) .

가 (Chi-square =
 2.364, P = 0.585).
 2 (2/2, 100%), 7 (7/10, 70%), 15
 - (15/17, 88.2%), 5 - (5/5,
 100%) .

8,9,21,22,30) Denis
 (anterior column), (middle column), (posteri
 8,9), ,

가 (Chi-square =
 3.442, P = 0.370).
 1 (1/10, 10%), 2 - (2/17, 11.8%), 4
 - (4/5, 80%) .

(each column)

가

(Chi-square = 9.108, P = 0.013).

가 (Chi-square = 33.000, P = 0.000).

52.0%, 66.7%, 92.9%, 가 ,
 14.3%, 53.6% .

가
 가

95.2%, 66.7%, 66.7%, 가 .
 16.8%, 66.7%

가 .
 가

92.9%, 80.0%, 96.3%,

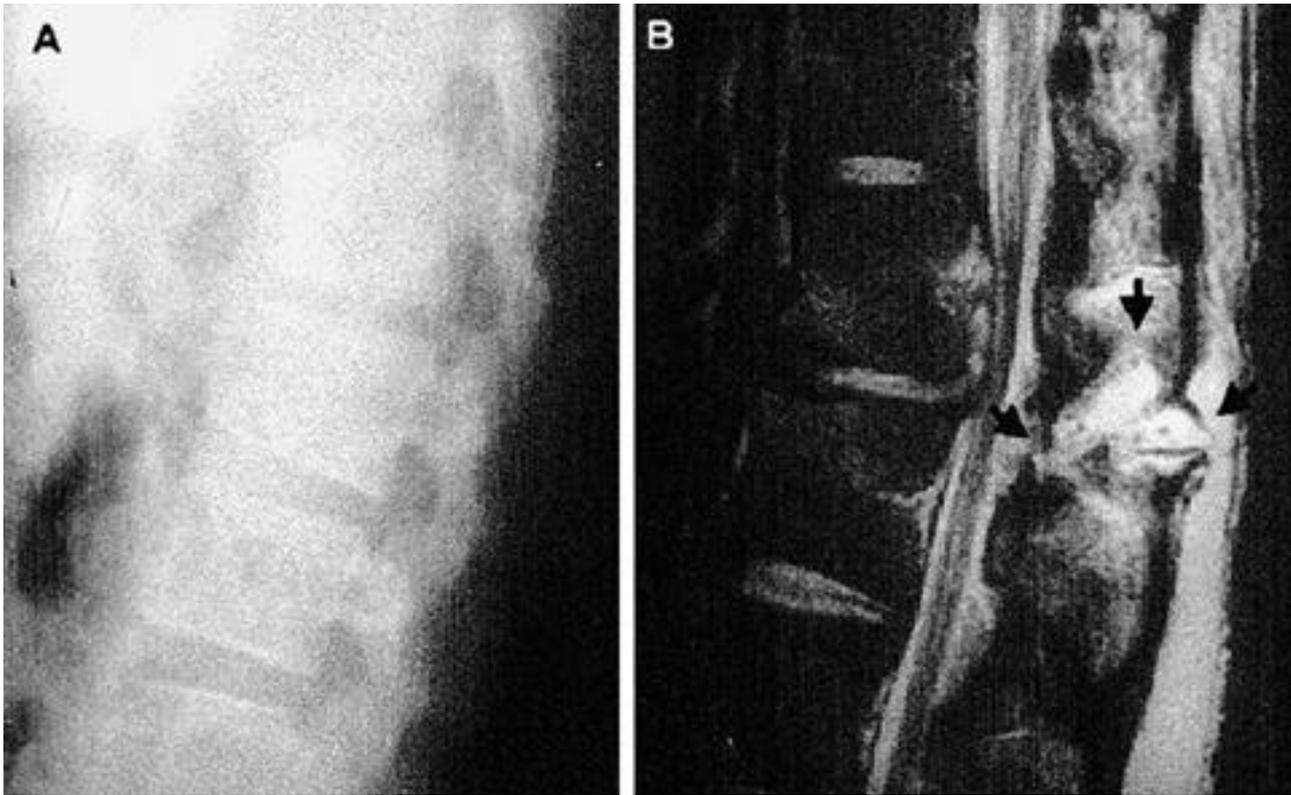


Fig. 1. Lateral radiography of a 25-year-old man shows flexion-distraction injury of L2-3. L2-3 facet joints are distracted(A). Fat-suppressed T2-weighted sagittal sequence of MR imaging shows disruption of supraspinous, interspinous ligament, and ligamentum flavum(B).

4-6,13,21,22,24,27) 가 7,15-18,20,25)
T2
5,6) T2
1,14,19,26,28,36)
가 (supine position)
(lateral decubitus position)
가 2), 가
가 , , 가
(Fig. 1).
. Emery 10)
가 , , T1 T2
3,12,14,18,29,31,32) T2
(dark signal) , 가

(Fig 2).

T2

가

T2

REFERENCES

- 1) **Atlas SW, Regenbogen V, Rogers LF, Kim KS** : The radiologic characterization of burst fractures of the spine. *AJR*, 147:575-82, 1986.
- 2) **Ballock RT, Mackerisic R, Abitol JJ, Cervilla V, Resnick D, Garfin SR** : Can burst fractures be predicted from plain radiographs? *J Bone Joint Surg [Br]*, 74:147-50, 1992.
- 3) **Blumenkopf B, Juneau PA** : Magnetic resonance imaging(MRI) of thoracolumbar fracture. *J Spinal Disorder*, 1:144-50, 1988.
- 4) **Brant-Zawadzki M, Miller EM, Federle MP** : CT in the evaluation of spine trauma. *AJR*, 136:369-75, 1981.
- 5) **Daffner RH, Deeb ZL, Goldberg AL, Kandabarow A, Rothfus WE** : The radiologic assessment of post-traumatic vertebral stability. *Skeletal Radiol*, 19:103-8, 1990.
- 6) **Daffner RH, Deeb ZL, Rothfus WE** : The posterior vertebral body line: importance in the detection of burst fractures. *AJR*, 148:93-6, 1987.
- 7) **Davis SJ, Tersei LM, Bradley WG, Jr, Ziemba MA, Bloze AE** : Cervical spine hyperextension injuries: MR findings. *Radiology*, 180:245-51, 1991.
- 8) **Denis F** : Spinal instability as defined by the three-column spine concept in acute spinal trauma. *Clin Orthop*, 189:65-76, 1984.
- 9) **Denis F** : The three column spine and its significance in the classification of acute spinal injuries. *Spine*, 8:817-31, 1983.
- 10) **Emery SE, Pathria MN, Wilber G, Massaryk T, Bohlman HH** : Magnetic resonance imaging of post traumatic spinal ligament injury. *J Spinal Disord*, 2:229-33, 1989.
- 11) **Ferguson RL, Allen BL, Jr** : A mechanistic classification of thoracolumbar spine fractures. *Clin Orthop*, 189:77-88, 1984.
- 12) **Flanders AE, Schaefer DM, Doan HT, Mishkin MM, Gonzalez CF, Northrup BE** : Acute cervical spine trauma: correlation of MR imaging findings with degree of neurologic deficit. *Radiology*, 177:25-33, 1990.
- 13) **Gehweiler JA, Daffner RH, Osborne RL, Jr** : Relevant signs of stable and unstable thoracolumbar vertebral trauma. *Skeletal Radiol*, 7:179-83, 1981.
- 14) **Georgy BA, Hesselink JR** : MR imaging of the spine: recent advances in pulse sequences and special techniques. *AJR*, 162:923-34, 1994.
- 15) **Goldberg AL, Rothfus WE, Deeb ZL, et al** : The impact of magnetic resonance on the diagnostic evaluation of acute cervicothoracic spinal trauma. *Skeletal Radiol*, 17:89-95, 1988.
- 16) **Grenier N, Gresselle JF, Vital JM, et al** : Normal and disrupted lumbar longitudinal ligaments: correlative MR and anatomic study *Radiology*, 171:197-205, 1989.
- 17) **Hackey DB, Asato R, Joseph PM** : Hemorrhage and edema in acute spinal cord compression: demonstration by MRI imaging. *Radiology*, 161:387-90, 1986.
- 18) **Harris JH, Yeakley JW** : Hyperextension-dislocation of the cervical spine: ligament injuries demonstrated by magnetic resonance imaging. *J Bone Joint Surg[Br]*, 74:567-70, 1992.
- 19) **Henkelman RM, Hardy PA, Bishop JE, Poon CS, Plewes DB** : Why fat is bright in RARE and fast spin-echo imaging. *J Magn Reson Imaging*, 2:533-40, 1992.
- 20) **Ho PSP, Yu S, Sether L, Wagner M, Ho KC, Haughton VM** : Ligamentum flavum: appearance on sagittal and coronal MR images. *Radiology*, 168:469-72, 1988.
- 21) **Holdsworth FW** : Fractures, dislocations, and fracture-dislocations of the spine. *J Bone Joint Surg [Br]*, 45:6-20, 1963.
- 22) **Holdsworth FW** : Fractures, dislocations, and fracture-dislocations of the spine. *J Bone Joint Surg [Am]*, 52:1534-51, 1970.

- 23) **Jelsma RK, Kirsch PT, Rice JF, et al** : *The radiographic description of thoracolumbar fractures. Surg Neurol, 18:230-6, 1982.*
- 24) **Kaye JJ, Nance EP** : *Cervical spine trauma. Orthop Clin North Am, 21:449-62, 1990.*
- 25) **Kliewer MA, Gray L, Paver J, et al**: **Acute spinal ligament disruption** : *MR imaging with anatomic correlation. J Magn Reson Imaging, 3:855-61, 1993.*
- 26) **Magerl F, Aebi M, Gertweib SD, Harms J, Nazarian S** : *A comprehensive classification of thoracic and lumbar injuries. Eur Spine J, 3:184-201, 1994.*
- 27) **McAfee PC, Yuan H, Fredrickson BE, Lubicky JP** : *The value of computed tomography in thoracolumbar fractures. J Bone Joint Surg [Am], 65:461-72, 1983.*
- 28) **McArdle CB, Crofford MJ, Mirfakhraee M, Amparo EG, Calhoun JS** : *Surface coil MR of spinal trauma: preliminary experience. AJNR, 7:885-93, 1986.*
- 29) **Mirvis SE, Geisler FH, Jelinek JJ, Joslyn JN, Gellad F** : *Acute cervical spine trauma: evaluation with 1.5-T MR imaging. Radiology, 166:807-16, 1988.*
- 30) **Nagel DA, Koogle TA, Piziali RL, Perkasch I** : *Stability of the upper lumbar spine following progressive disruptions and the application of individual internal and external fixation devices. J Bone Joint Surg [Am], 63:62-70, 1981.*
- 31) **Neumann P, Nordwall A, Osvalder AL** : *Traumatic instability of the lumbar spine. Spine, 20:1111-21, 1995.*
- 32) **Petersilge CA, Pathria MN, Emery SE, Masaryk TJ** : *Thoracolumbar burst fractures: evaluation with MR imaging. Radiology, 194:49-54, 1995.*
- 33) **Roaf R** : *A study of the mechanics of spinal injuries. J Bone Joint Surg [Br], 42:810-23, 1960.*
- 34) **Terk MR, Hume-Neal M, Fraipont M, Ahmadi J, Colletti PM** : *Injury of the posterior ligament complex in patients with acute spinal trauma: Evaluation by MR imaging. AJR, 168:1481-6, 1997.*
- 35) **Tracy PT, Wright RM, Hanigan WC** : *Magnetic resonance imaging of spinal trauma. Spine, 14:292-301, 1989.*
- 36) **Zee CS, Segall HD, Terk MR, et al** : *SPIR MRI in spinal diseases. J Comput Assist Tomogr, 16:356-60, 1992.*

