

:
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 가 7 13 21
 3 , 4 , 5 , 1 . 3
 3 -6
 : 13 가 9 (69.2%), 가 2 (15.4%)
 , 2 (15.4%) 가 . 9 7 T2
 가 4 가 2
 T2 가 가 1

:
 가 , , , , ,
 30% 가
 90% 가
 (1, 2). , , , , ,
 (instability) 가 가
 (3). 가 가 가 Novalis
 radiosurgery unit (BrainLab, Heimstetten, Germany)
 가
 (4). 가
 , , , , , ,
 Novalis
 (MRI)

1
2

:

2003 11 2005 6 method) MRI (segmental image fusion CT method) MRI CT

13 (MRI) 가 7 21 MRI , “inverse treatment planning technique”

2 , 2 , 1 , 1 1 가 6 , (1-5 , 2.9)

가 1 64 , 25.76Gy () 가 3 가 가 4 .2 (MRI) 가 가 가 MRI

(Exactrac , stereotactic body frame, BrainLab) 3D (Rapidia, Infinitt, Seoul, Korea) 가

1.5T MRI (Symphony, Siemens Medical Systems, Erlangen, Germany) 4 가 5% MDCT (Multidetector - row CT) (Volume Zoom, Siemens Medical Systems, Erlangen, Germany) . MR 3 MRI MRI 3 -6 MRI TR/TE 450/12 T1 가가 TR/TE 3600/108 T2 T1 3 mm, 4 mm FOV 280 mm 150×256 , T1 96×256 , T2 270×512 . 0.1 mmol/kg Gadolinium - DTPA (Magnevist, Schering, Berlin, Germany)가 . CT 13 8 3 , 4 , 5 , 1 (pedicle) 120 kVp, 110 mAs, 50 cm, collimation 2.5 mm, 3 mm, (increment) 2 mm 5 8 5 가가 T2 가 9 , 가 가 3 가 angle orthogonal , 1 가 T1 가 (median follow - up period) MRI CT , BrainLab platform software 4 , 7 2 1 (PatXfer 4.21) dicom Brainscan soft-ware (Version 5.1) 가 , 3 3 , 1 6 , 1 15 가 CT 가 9 (69.2%), CT CT () 가 2 (15.4%) , 2 (15.4%) CT MRI MR 가 11 (84.6%)

9 52.3% 10-91%

3 가 6 (compression) 가 4

가 가 4

T2

9 6 (Fig. 1), 2 (Fig. 2).

T2 가 1 (5).

T2 가 가 (seminoma),

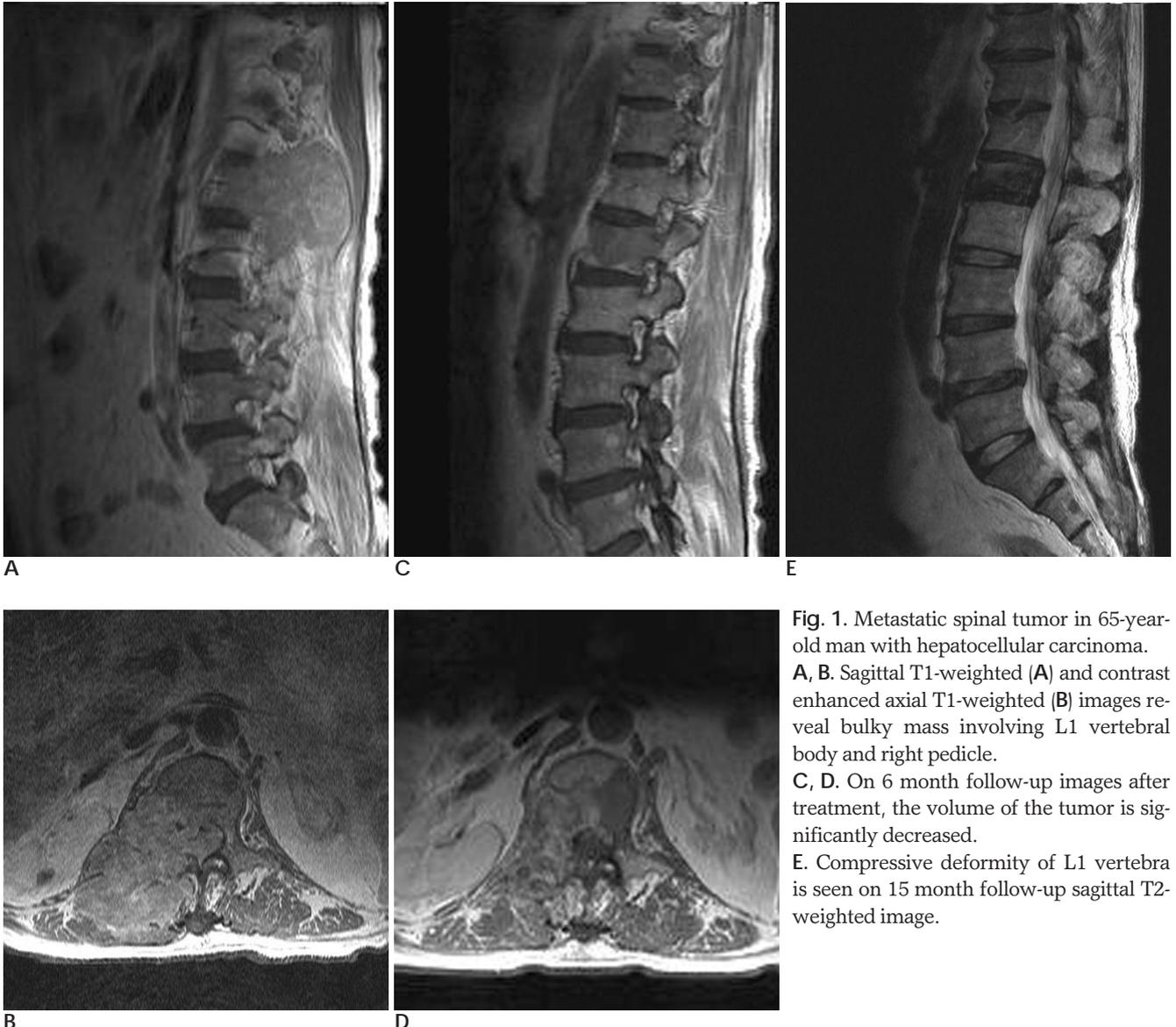


Fig. 1. Metastatic spinal tumor in 65-year-old man with hepatocellular carcinoma. **A, B.** Sagittal T1-weighted (**A**) and contrast enhanced axial T1-weighted (**B**) images reveal bulky mass involving L1 vertebral body and right pedicle. **C, D.** On 6 month follow-up images after treatment, the volume of the tumor is significantly decreased. **E.** Compressive deformity of L1 vertebra is seen on 15 month follow-up sagittal T2-weighted image.

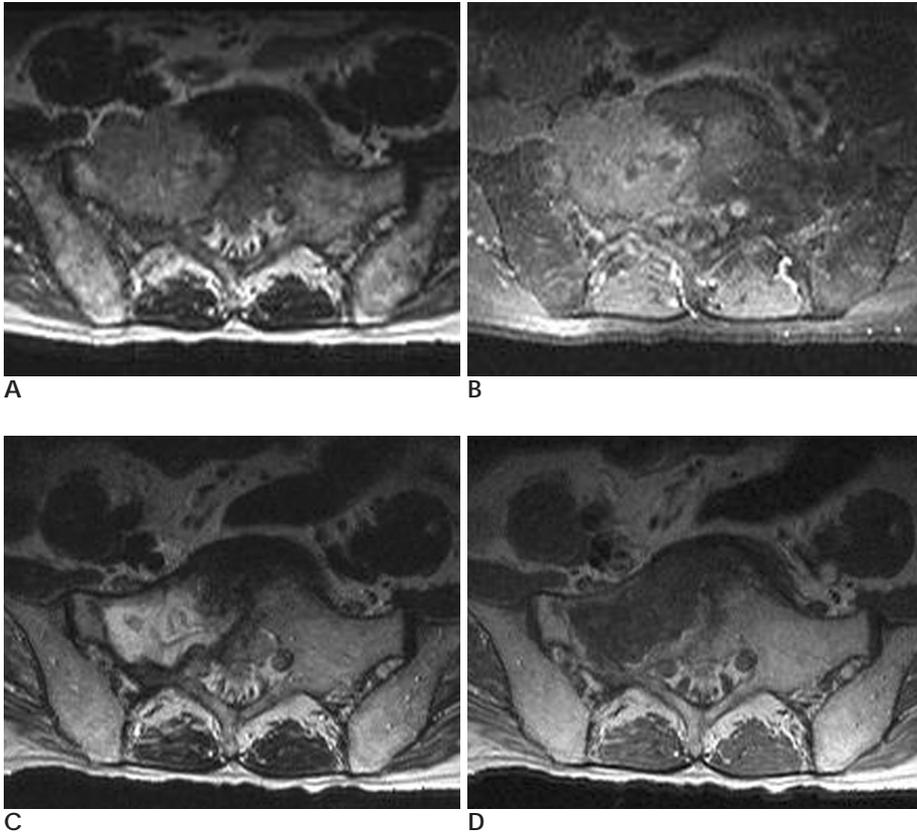


Fig. 2. Metastatic spinal tumor in 67-year-old man with lung cancer. A, B. Metastatic lesion is noted in sacrum on axial T2-weighted (A) and contrast enhanced T1-weighted (B) images. C, D. The mass was accompanied volume loss with increased signal intensity on T2-weighted image (C) obtained on 3 months after treatment. Contrast enhanced axial T1-weighted image (D) shows extensive central tumor necrosis with mild peripheral enhancement.

(6), 가 (7). 가 3 (mMLC : micro Multi - Leaf Collimator) 가 가 (8). (14). Co - 60 (Eleckta, Stockholm, Sweden) 가 (9 - (Photon energy) 6MV Varian Clinac 600SR 가 가 Cyberknife (Accuray, Sunnyvale, CA) 가 CT CT MRI CT 가 69.2% 가 2 84.6% (8). (13), (5, 6, 8, 9, 12, 13) 35% 1990 가 2000 11 (FDA) 484

9 4

2
가 가

T2

4

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가 가 2

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MR

1. Cobb CA, Leavens ME, Eckles N. Indications for nonoperative treatment of spinal cord compression due to breast cancer. *J Neurosurg* 1977;47:653-658
2. Wong DA, Fornasier VL, MacNab I. Spinal metastases: the obvious, the occult, and the impostors. *Spine* 1990;15:1-4
3. Black P. Spinal metastases: current status and recommended guidelines for management. *Neurosurgery* 1979;5:726-746
4. Helweg-Larsen S. Clinical outcome in metastatic spinal cord compression: a prospective study of 153 patients. *Acta Neurol Scand* 1996;94:269-275
5. Daw HA, Markman M. Epidural spinal cord compression in cancer patients: diagnosis and management. *Cleve Clin J Med* 2000;67:497-504
6. Gilbert RW, Kim JH, Posner JB. Epidural spinal cord compression from metastatic tumor: diagnosis and treatment. *Ann Neurol* 1978;3:40-51
7. Rao S, Badani K, Schildhauer T, Borges M. Metastatic malignancy of the cervical spine: a nonoperative history. *Spine* 1992;17:S407-S412
8. Regine WF, Tibbs PA, Young A, Payne R, Saris S, Kryscio RJ, et al. Metastatic spinal cord compression: a randomized trial of direct decompressive surgical resection plus radiotherapy vs radiotherapy alone. *Int J Radiat Oncol Biol Phys* 2003;57(2 Suppl):S125
9. Greenberg HS, Kim JH, Posner JB. Epidural spinal cord compression from metastatic tumor: results with a new treatment protocol. *Ann Neurol* 1980;8:361-366
10. Pascal-Moussellard H, Broc G, Pointillart V, Simeon F, Vital JM, Senegas J. Complications of vertebral metastasis surgery. *Eur Spine J* 1998;7:438-444
11. Wise JJ, Fischgrund JS, Herkowitz HN, Montgomery D, Kurz LT. Complication, survival rates, and risk factors of surgery for metastatic disease of the spine. *Spine* 1999;24:1943-1951
12. Gokaslan ZL, York JE, Walsh GL, McCutcheon IE, Lang FF, Putnam JB, et al. Transthoracic vertebrectomy for metastatic spinal tumors. *J Neurosurg* 1998;89:599-609
13. Siegal T, Siegal T. Surgical decompression of anterior and posterior malignant epidural tumors compressing the spinal cord: a prospective study. *Neurosurgery* 1985;17:424-432
14.
2002;4:231-237

Metastatic Spinal Tumors: MR Findings after Novalis Radiosurgery¹

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Purpose: To assess the therapeutic effect of Novalis radiosurgery for metastatic spinal tumors and evaluate the changes after treatment using MR imaging.

Materials and Methods: Between November 2003 and June 2005, 21 patients with metastatic spinal tumors underwent Novalis radiosurgery. Of these patients, the 7 with 13 metastatic spinal tumors who had undergone follow-up MR imaging were included in this study. The tumor locations were cervical spine in three, thoracic spine in four, lumbar spine in five and sacrum in one. During the first three months after Novalis radiosurgery, follow-up MRI was performed monthly and subsequently at 3 - 6-month intervals. On MR imaging, the volume of the tumors, the changes of their signal intensities and any changes in adjacent spinal cord were evaluated.

Results: Among the 13 lesions, 9 were decreased in volume (69.2%), 2 were stable (15.4%) and 2 were slightly increased. Seven of 9 lesions showed decreased signal intensity on T2 weighted images and 4 had compressive deformity. Two of 9 lesions had increased T2 signal intensity and tumor necrosis were detected on contrast-enhanced MR imaging. No changes in spinal cord were noted in any of the lesions. Those changes were detected on MRI obtained 1 month after Novalis surgery and the lesion sizes were gradually changed up to 3 months.

Conclusion: Novalis radiosurgery was effective for the treatment of metastatic spinal tumor and the suppression of tumor growth. The estimation of therapeutic effect and detecting complication were precisely evaluated on MR imaging.

Index words : Spine, secondary neoplasms
Spine, MR
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