



:  
 : 25 37  
 , , , 3  
 ,  
 T1 - T2 - Fisher  
 exact test  
 : T1 - ,  
 13 (52%), 8 (32%), 4 (16%) ,  
 25 (68%), 12 (32%)  
 ( $p < 0.05$ )  
 5 10  
 (58.8%) 2 (8.3%) ( $p < 0.01$ ).  
 3 가 20 (80%)  
 16 (43%) , ( $p < 0.01$ ). T2 -  
 12% 32% ( $p$   
 $> 0.05$ ), 36% 3% ( $p < 0.05$ ), 52% 65% ( $p > 0.05$ )  
 12 (48%), 9 (36%)  
 18 (49%), 19 (51%) 가  
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 , 가 5 , 3  
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가  
 가 가 (1-3).  
 가 23 25 37  
 37  
 14 , 9  
 가 19 , 가 18  
 38-79 ( , 58 )  
 29-78 ( , 55 )  
 가 , 18  
 5  
 , 32 1 6

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

1.5 - T (GE Signa Advantage; General Electric Medical Systems, Milwaukee, WI, U.S.A.) 3 mm, 1 5 가 5 가

mm, echo train length 16 T1 - (350 - 450 msec/11 - 17 msec [TR/TE]) T2 - test 0.05 가 Fisher exact

(3000 - 3500 msec/108 - 144 msec [TR/TE]) Gadolinium - DTPA (Magnevist, Schering, Berlin, Germany) T1 - T1 -

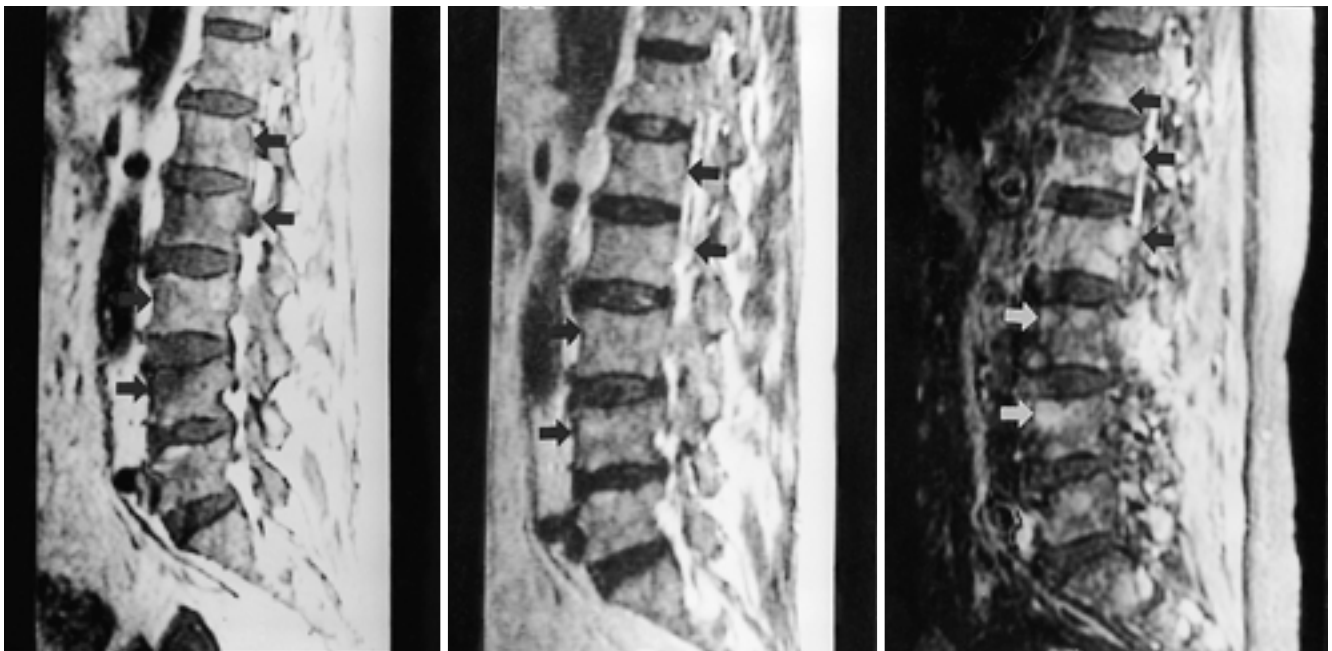
6 T1 - T2 - , 3 T1 -

T2 - 3 (12%) (Fig. 1) 12 (32%) (Fig. 9 (36%) (Figs.3, 4) 1 (3%), 13 (52%) 24 (65%) 가

(salt - and - pepper) T1 - (Fig. 5) T2 - (p < 0.05) (Table). 13

(52%) (Fig. 1), 8 (32%) (Fig. 4), 4 (16%) (Fig. 3) 25 (68%)(Fig. 2), 12 (32%)

T1 - T2 -



**Fig. 1.** Multiple myeloma with focal pattern in a 60-year-old man.  
**A.** Sagittal T1-weighted image shows multiple variable sized hypointense lesions (arrows) at lumbar spine.  
**B.** On sagittal T2-weighted image, these lesions are hyperintense (arrows).  
**C.** Gadolinium-enhanced fat suppressed T1-weighted image shows multiple well enhancing masses (arrows). There are more than five lesions in one vertebra and three consecutive vertebrae are involved.

( $p < 0.05$ )

5 43% 20 80% (Figs.1, 3) 16  
 13 6 46% (Fig. 1) 12 48%, 9  
 25 2 5 8% 18 49% , 19 51%  
 가 (p < 0.05). 가 .  
 3

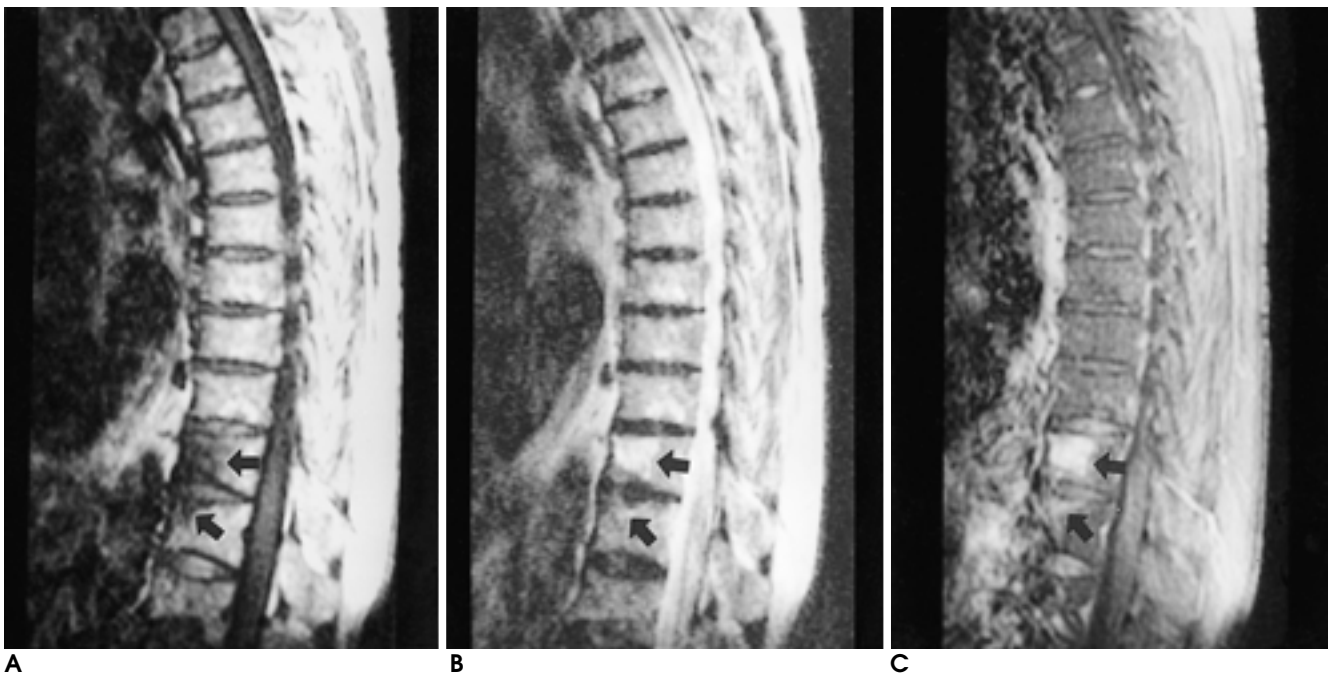
**Table.** Multiple Myeloma versus Metastasis on MR Findings

		Multiple myeloma (n = 25)	Metastasis (n = 37)
Signal Intensity on FSE T2WI			
High-SI	( $p > 0.05$ )	12% (n = 3)	32% (n = 12)
Iso-SI	( $p < 0.05$ )	36% (n = 9)	3% (n = 1)
Low-SI	( $p > 0.05$ )	52% (n = 13)	65% (n = 24)
Infiltration and enhancement patterns			
Focal	( $p > 0.05$ )	52% (n = 13)	68% (n = 25)
Diffuse	( $p > 0.05$ )	32% (n = 8)	32% (n = 12)
Salt and pepper	( $p < 0.05$ )	16% (n = 4)	0%
*More than five lesions within one vertebra in focal pattern (n = )	( $p < 0.05$ )	46% (n = 6/n' = 13)	8% (n = 2/n' = 25)
Involvement of three consecutive vertebrae	( $p < 0.01$ )	80% (n = 20)	43% (n = 16)
Paraspinal mass	( $p > 0.05$ )	36% (n = 9)	51% (n = 19)
Epidural mass	( $p > 0.05$ )	48% (n = 12)	49% (n = 18)

\* n': each number of focal pattern in multiple myeloma and metastasis

FSE T2WI: Fast Spin Echo T2-weighted Image

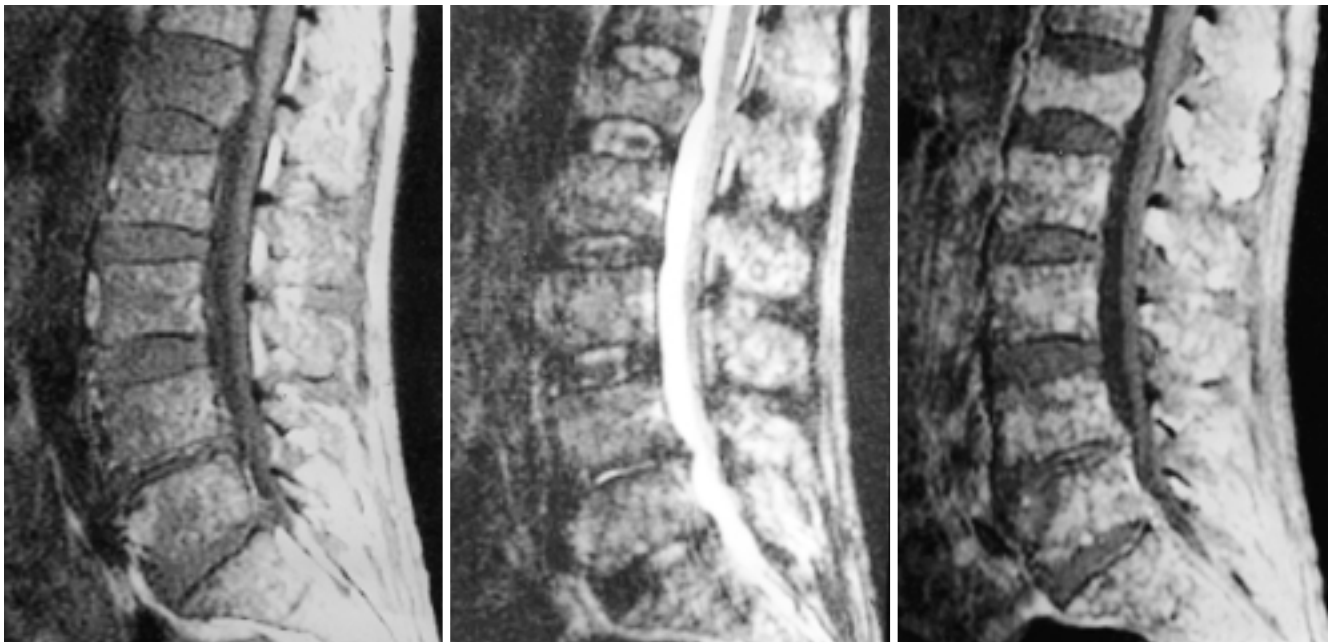
SI: signal intensity

**Fig. 2.** Vertebral metastasis with focal pattern in a 67-years-old man.

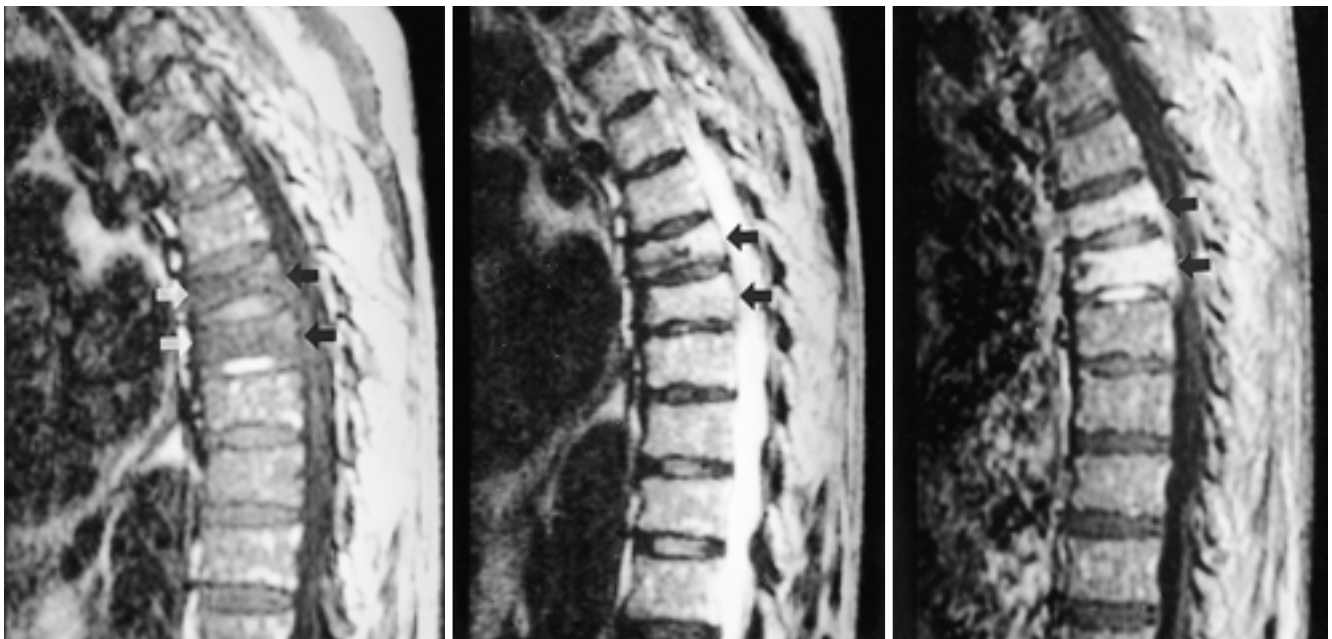
**A.** Sagittal T1-weighted image shows focal hypointense lesions (arrows) at anterior portion of L1 and L2 vertebral bodies.

**B.** On sagittal T2-weighted image, the lesions reveal hyperintense signal intensity (arrows).

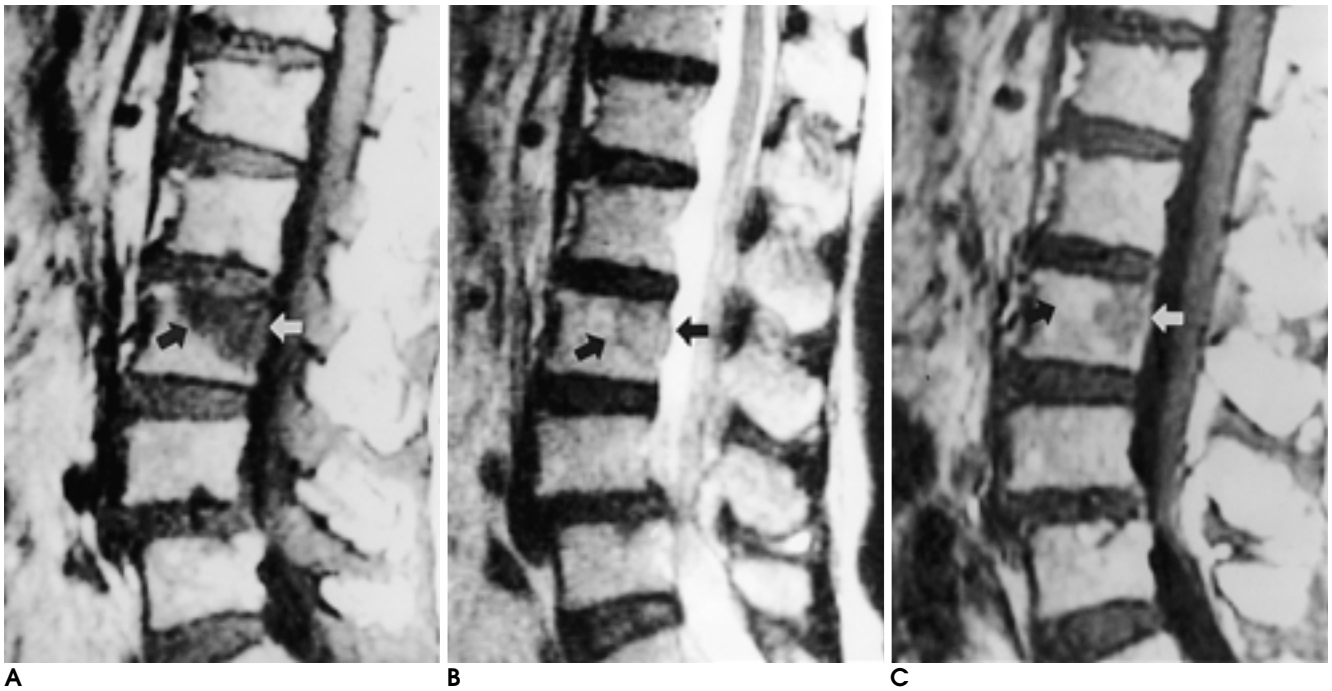
**C.** Gadolinium-enhanced fat-suppressed T1-weighted image shows intense enhancement of lesions (arrows).



**Fig. 3.** Multiple myeloma with ' salt & pepper ' pattern in a 59-years-old man.  
**A.** Sagittal T1-weighted image shows innumerable decreased signal intensity in lumbar spine.  
**B.** Sagittal T2-weighted image shows heterogeneous signal intensity lesions.  
**C.** Gadolinium-enhanced fat-suppressed T1-weighted image reveals heterogeneous enhancement.



**Fig. 4.** Multiple myeloma with diffuse pattern in a 69-years-old man.  
**A.** On sagittal T1-weighted image T7 and T8 vertebrae show diffusely hypointense signal intensity (arrows).  
**B.** On sagittal T2-weighted image T7 and T8 vertebrae are isointense (arrows) to the signal of adjacent vertebrae.  
**C.** On contrast-enhanced fat-suppressed T1-weighted image T7 and T8 vertebrae show diffuse, relatively homogeneous contrast enhancement (arrows).



**Fig. 5.** Metastasis with focal pattern in a 74-years-old woman.

**A.** Sagittal T1-weighted image shows a focal hypointense lesion (arrows) at L2 vertebral body.

**B.** Sagittal T2-weighted image shows a focal heterogeneously hypointense lesion (arrows) at the L2 vertebral body.

**C.** The mass at L2 vertebral body shows heterogeneous contrast enhancement (arrows) on sagittal contrast-enhanced T1-weighted image.

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(Fig. 4C).

Rahmouni (5) T2 - 가 , 가 (4, 12, 13). Mouloupoulos (4) (variegated pattern) 14% 16%

. Fruehwald (6) T2 - 가 , 가 88% 7.6% 66 5

22 T2 - 3 12% , 88% 7.6% 가 (13) 50%

(7, 8) T2 - 가 T2 - 가 가 가 가

(9, 10). T2 - 가 T2 - 가 가 가 가

T1 - T1 - Kim (14) Monoupoulos (4) 5 2 17 38 24

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(15).

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. Kim (14)

(13)

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## MR Distinction between Multiple Myeloma and Metastasis Involving the Spine<sup>1</sup>

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**Purpose:** To differentiate multiple myeloma from metastasis involving the spine at MR imaging.

**Materials and Methods:** Twenty-five patients with multiple myeloma and 37 with vertebral metastasis were included in this study. MR images were retrospectively analyzed with regard to infiltration and enhancement patterns, signal intensity, the involvement of three consecutive vertebrae, the number of lesions within one vertebra, and paraspinal and epidural masses. Using a 1.5-T imager, we obtained sagittal and axial, unenhanced and enhanced T1-weighted images, and fast spin-echo images. For statistical analysis, Fisher's exact test was used.

**Results:** All cases of multiple myeloma and metastasis showed low signal intensity on T1-weighted images, and there were no significant differences in signal intensities or enhancement patterns. Infiltration and enhancement patterns were classified as focal (52% in multiple myeloma vs 68% in metastasis,  $p > 0.05$ ), diffuse (32% vs 32%,  $p > 0.05$ ) or salt and pepper (16% vs 0%,  $p < 0.05$ ) pattern. Differentiation between multiple myeloma and metastasis was based on two criteria: the involvement of three consecutive vertebrae (80% vs 43%,  $p < 0.01$ ), and the presence of more than five lesions within one vertebra (59% vs 8%,  $p < 0.05$ ). On fast spin-echo T2-weighted images, signal intensity was as follows: hyperintensity (12% vs 32%,  $p > 0.05$ ), isointensity (36% vs 3%,  $p < 0.05$ ), and hypointensity (52% vs 65%,  $p > 0.05$ ). Paraspinal and epidural masses played little part.

**Conclusion:** The salt and pepper infiltration pattern, the presence of more than five lesions within one vertebra, and the involvement of more than three consecutive vertebrae were useful MR findings for differentiation between multiple myeloma and metastasis involving the spine. In most cases, however, it is difficult to distinguish between the two conditions.

**Index words :** Spine, MR

Spine, primary neoplasms

Spine, secondary neoplasms

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<b>2001 / 2 / 7 - 9</b> <b>JSNR, Japanese Society of Neuroradiology 30th Annual Meeting</b> <ul style="list-style-type: none"> <li>• Subject: Imaging X-Ray Medicine Neuroscience/Neurology</li> <li>• Location: Osaka Japan</li> <li>• Contact: Natl. Osaka Hosp., Dept. of Radiology, Dr. Masanori Mitomo, Osaka, Japan</li> <li>• Phone: (06) 6942-1331 Countryphone: + 81</li> <li>• Fax: (06) 6943-6467</li> <li>• E-Mail: mitomo@onh.go.jp</li> </ul>	<b>2001 / 3 / 19 - 23</b> <b>SCBT-MR, 24th Annual Meeting of the Society for Computed Body Tomography and Magnetic Resonance</b> <ul style="list-style-type: none"> <li>• Subject: Imaging X-Ray Magnetic Resonance Imaging</li> <li>• Location: South Beach Florida: Loews Miami Beach Hotel USA</li> <li>• Contact: Soc. f. Computed Body Tomography, Matrix Meetings, P.O. Box 1026, Rochester, MN 55903-1026, USA</li> <li>• Phone: (507) 288-5620 Countryphone: + 1</li> <li>• Fax: (507) 288-0014</li> </ul>
<b>2001 / 3 / 2 - 6</b> <b>ECR 2001: 13. European congress of Radiology</b> <ul style="list-style-type: none"> <li>• Subject: Imaging X-Ray</li> <li>• Location: Vienna Wien Austria</li> <li>• Contact: European Radiology Association, ECR Office, Neutorgasse 9/2A, A-1010 Vienna, Austria</li> <li>• Fax: + 43 1 533 40 64 9</li> <li>• E-Mail: office@ecr.org</li> <li>• Internet: http://www.ecr.org/</li> </ul>	<b>2001 / 3 / 25 - 30</b> <b>SGR, 30th Annual Meeting and Postgraduate Course of the Society of Gastrointestinal Radiologists</b> <ul style="list-style-type: none"> <li>• Subject: Imaging X-Ray Medicine Gastroenterology</li> <li>• Location: Scottsdale Arizona: Marriott Camelback USA</li> <li>• Contact: Soc. of Gastrointestinal Radiologists, Intl. Meeting Mgrs., K. Schmitt, 4550 Post Oak Place, Suite 342, Houston, TX 77027, USA</li> <li>• Phone: (713) 965-0566 Countryphone: + 1</li> <li>• Fax: (713) 960-0488</li> <li>• E-Mail: imm@earthlink.net</li> <li>• Internet: http://www.sgr.org</li> </ul>
<b>2001 / 3 / 3 - 8</b> <b>SCVIR, Society of Cardiovascular &amp; Interventional Radiology Annual Scientific Meeting</b> <ul style="list-style-type: none"> <li>• Subject: Medicine Cardiology Vascular Diseases Imaging X-Ray</li> <li>• Location: San Antonio Texas: San Antonio Convention Center USA</li> <li>• Contact: SCVIR, 10201 Lee Hwy, Ste 500, Fairfax, VA 22030, USA</li> <li>• Phone: (703) 691-1805 Countryphone: + 1</li> <li>• Fax: (703) 691-1855</li> <li>• E-Mail: info@scvir.org</li> <li>• Internet: http://www.scvir.org</li> </ul>	<b>2001 / 4 / 4 - 8</b> <b>STR, Society of Thoracic Radiology Meeting</b> <ul style="list-style-type: none"> <li>• Subject: Imaging X-Ray Medicine Internal Medicine</li> <li>• Location: Boca Raton Florida: Boca Raton Resort &amp; Club USA</li> <li>• Contact: Soc. of Thoracic Radiology, c-o Ryals &amp; Associates, P.O. Box 1925, Roswell GA 30077, USA</li> <li>• Phone: (770) 641-9773 Countryphone: + 1</li> <li>• Fax: (770) 552-9859</li> <li>• E-Mail: webmaster@ryalsmeet.com</li> <li>• Internet: http://www.ryalsmeet.com</li> </ul>
<b>2001 / 3 / 11 - 14</b> <b>AIUM, American Institute of Ultrasound in Medicine 45th Annual Convention</b> <ul style="list-style-type: none"> <li>• Subject: Imaging Ultrasound Medicine</li> <li>• Location: Orlando Florida USA</li> <li>• Contact: Amer. Inst. of Ultrasound in Medicine, Stephanie Reisberg, 14750 Sweitzer Lane, Suite 100, Laurel, MD 20707-5906, USA</li> <li>• Phone: (301) 498-4100 Countryphone: + 1</li> <li>• Fax: (301) 498-4450</li> <li>• E-Mail: sreisberg@aium.org</li> <li>• Internet: http://www.aium.org</li> </ul>	<b>2001 / 4 / 21 - 27</b> <b>ISMRM, 9th Annual Scientific Meeting and Exhibition of the International Society of Magnetic Resonance in Medicine</b> <ul style="list-style-type: none"> <li>• Subject: Medicine Imaging Magnetic Resonance Imaging</li> <li>• Location: Glasgow: Scottish Exhibition &amp; Conf. Centre UK</li> <li>• Contact: Intl. Soc. f. Magnetic Resonance in, Medicine, 2118 Milvia St, Ste 201, Berkeley, CA 94704, USA</li> <li>• Phone: (510) 841-1899 Countryphone: + 1</li> <li>• Fax: (510) 841-2340</li> <li>• E-Mail: info@ismrm.org</li> <li>• Internet: http://www.ismrm.org</li> </ul>