

1

1 2 3 4 5 6 7  
8 9 10

•

$$\vdots$$

9

9

가 4, CT 4, (MRI) 6, CT, MR

: 가 6 , 가 3 , 50 88 62 .

가 4 가 2 , 1 , 1  
1 .

, 1 , 1 , 1 2 , 2 , 1  
 3 , 6 . MRI 6 T1  
 , T2

: 가 .

가 .

(1, 2). Bloom (3) 70 가

가

가 (4, 5)

9

가

8  
9가  
10

2005 4 7

2005 5 23

1996 1 2004 8

9

9 , 4 , CT

4 , (MRI) 6 . CT MRI

Table 1

MRI T1 (TR/TE, 400 - 50 88 가 6 , 가 3

560/12 - 25) T2 (TR/TE, 1600 - 5083/60 - 119) 62 .

Gadolinium - DTPA T1

가 4 가

2 , 1 , 1

가 1 .

CT , MR

MR T1 T2

2 , 2 , 1 , 1 , 1 ,

1 1 3 , 6

CT

**Table 1.** Clinical and Imaging Findings in Nine Patients with Metastatic Bone Tumors with Sunburst Periosteal Reaction

| Age (y)/<br>Sex | Origin of<br>Primary Tumor | Symptom                        | Operative<br>history  | Kind of<br>Imaging             | Imaging Findings |                    |  |
|-----------------|----------------------------|--------------------------------|-----------------------|--------------------------------|------------------|--------------------|--|
|                 |                            |                                |                       |                                | Metastatic site  | Type of metastasis | Signal intensity   |
| 53/F            | Stomach                    | Painful swelling<br>of index   | Gastrectomy<br>(1 yr) | Radiography<br>MR<br>Bone scan | Phalanx          | Osteolytic         | Intermediate on T1-WI,<br>Heterogenous high on T2-WI,<br>Good homogenous enhancement |
| 69/M            | Stomach                    | Lower leg<br>pain              | Gastrectomy<br>(4 yr) | Radiography<br>MR<br>Bone scan | Tibia            | Osteoblastic       | Intermediate on T1-WI,<br>Heterogenous high on T2-WI<br>Good homogenous enhancement  |
| 50/M            | Stomach                    | Chest pain                     | -                     | Radiography<br>CT<br>MR        | Rib              | Osteoblastic       | Intermediate on T1-WI<br>Heterogenous high on T2-WI<br>Good homogenous enhancement   |
| 57/M            | Stomach                    | Upper arm pain                 | -                     | Radiography                    | Humerus          | Osteolytic         |  |
| 70/F            | Lung                       | Shoulder pain                  | -                     | Radiography<br>CT<br>MR        | Scapula          | Osteoblastic       | Intermediate on T1-WI,<br>Heterogenous high on T2-WI<br>Mild homogenous enhancement  |
| 50/F            | Lung                       | Pelvic pain                    | -                     | Radiography<br>CT<br>MR        | Ilium            | Osteolytic         | Intermediate on T1-WI,<br>Heterogenous high on T2-WI<br>Good homogenous enhancement  |
| 88/M            | Prostate                   | Back pain                      | -                     | Radiography<br>CT<br>Bone scan | Lumbar spine     | Osteoblastic       |  |
| 58/M            | HCC                        | Upper arm pain<br>and swelling | -                     | Radiography<br>MR<br>Bone scan | Humerus          | Osteoblastic       | Intermediate on T1-WI,<br>Heterogenous high on T2-WI<br>Good homogenous enhancement  |
| 67/M            | Unknown                    | Shoulder pain                  |                       | Radiography                    | Scapula          | Osteoblastic       |  |

Note. - Dash(-) indicates absent

4  
가  
MRI 6 T1 가  
3  
1  
, T2 30%  
(6).  
(7).



**Fig. 1.** A 69-year-old man with stomach adenocarcinoma.

**A.** Plain radiograph shows a large, destructive bone-forming lesion in the epiphyseal and metadiaphyseal area of the right proximal tibia with sunburst periosteal reaction on the lateral surface of the tibia.

**B, C.** Coronal T1-weighted spin-echo and axial T2-weighted fast spin-echo MR images demonstrate an extensive lesion occupying the nearly whole tibia with soft tissue component extending from the medullary space.

**D.** Gadolinium-enhanced axial T1-weighted spin-echo MR image obtained with fat saturation shows the homogenous enhancement of the entire lesion without a central necrotic portion.

**E.** Bone scan reveals the multiple areas of markedly increased activity.

가 : 가

가 가 (4) , 가

가 , , , (5) , , , 가

가

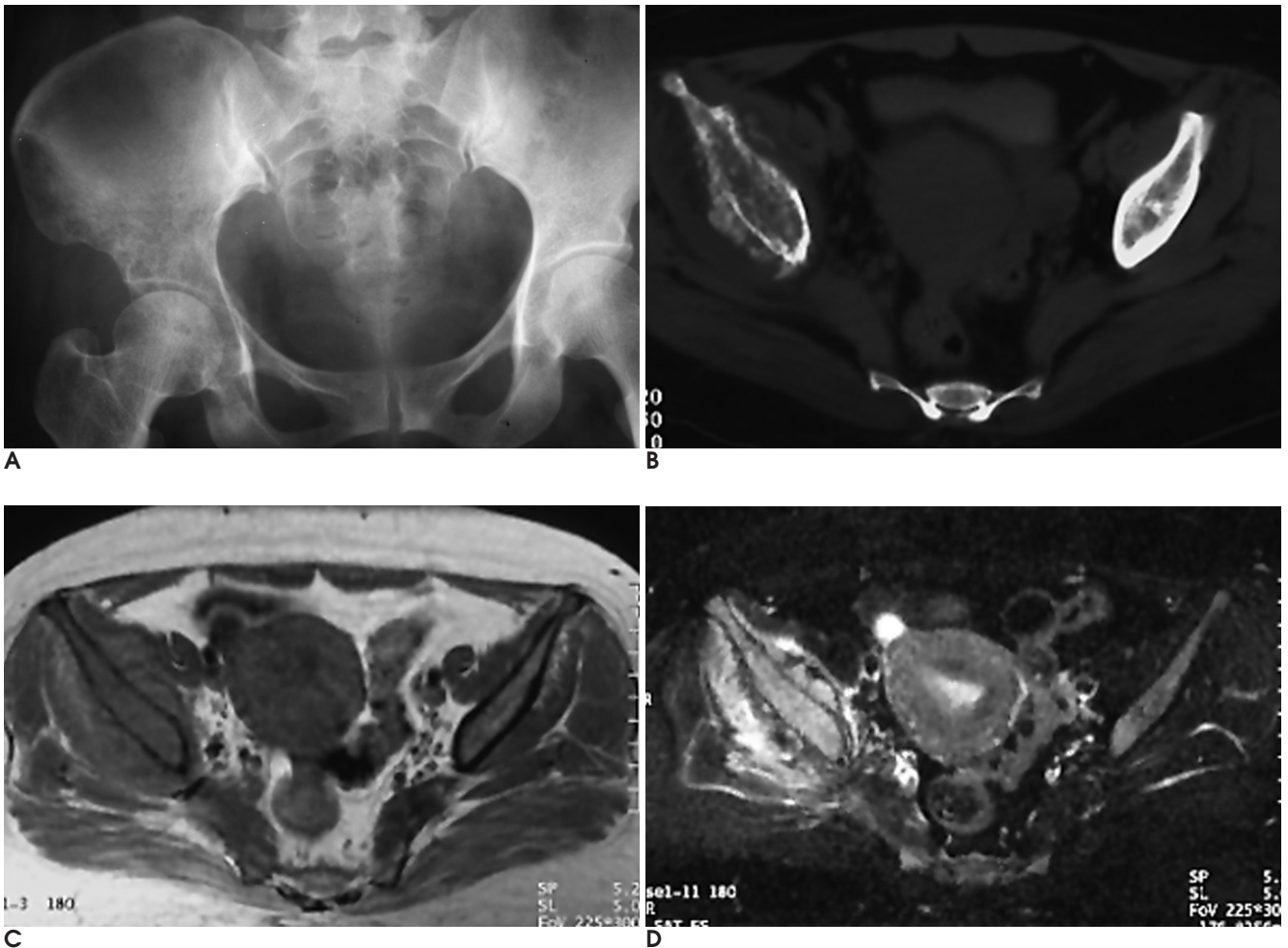
Bloom (3) 70%가 가

70 가 (8) Bloom (3) 4% (3/70)

3 가 4 가 Bloom (3) 70 가 6

1 가 Bloom

62



**Fig. 2.** A 50-year-old woman with lung adenocarcinoma.  
**A.** Plain radiograph shows an ill-defined osteolytic lesion in the right iliac bone and acetabulum.  
**B.** CT scan shows an ill-defined osteolytic lesion in the right iliac bone with sunburst periosteal reaction.  
**C.** Axial T1-weighted spin-echo MR image reveals shows intermediate signal intensity lesion in the bone marrow of the right iliac bone with extraosseous soft tissue mass formation.  
**D.** Axial fat-suppressed T2-weighted fast spin-echo MR image demonstrates high signal intensity of the bone marrow and extraosseous soft tissue mass.

70 (carcinoid) 1  
1

가 (9).

가 .

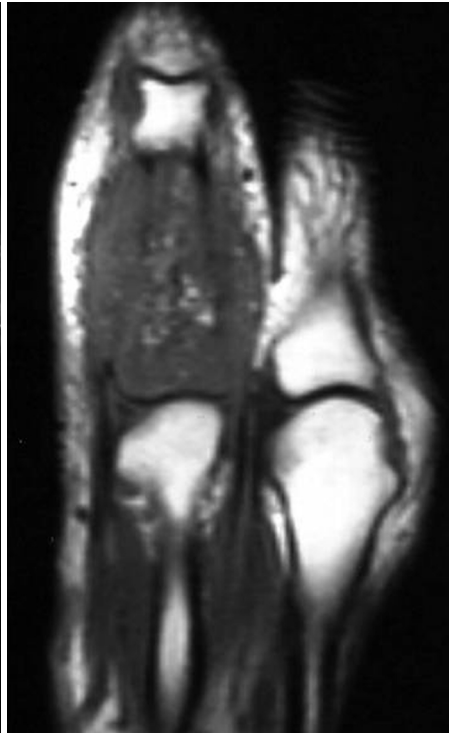
가 , , (11).

(7, 10). Bloom (3)

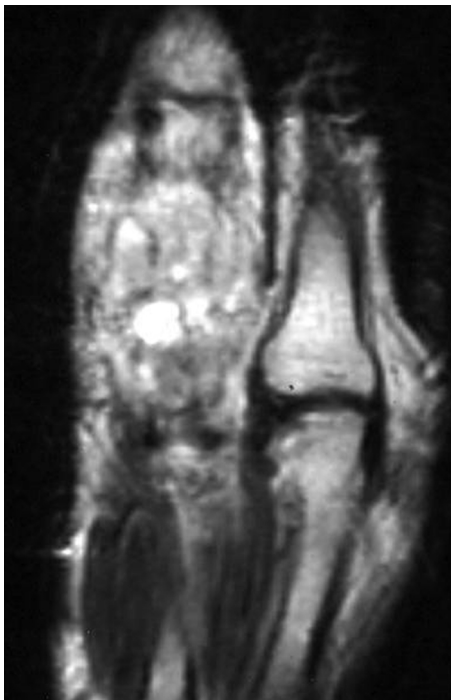
0.1%,



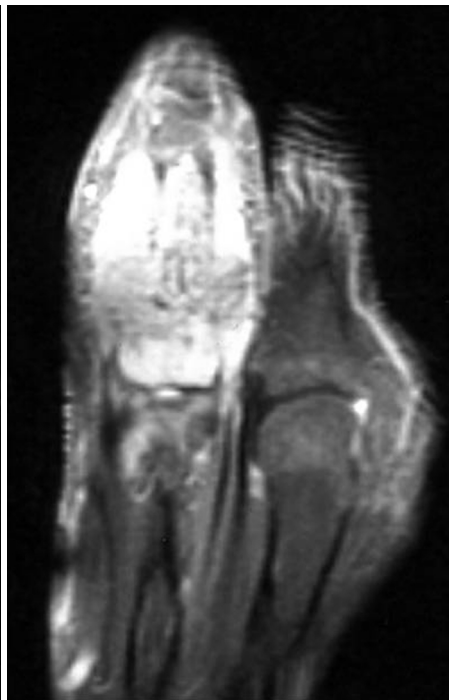
A



B



C



D

**Fig. 3.** A 53-year-old woman with stomach adenocarcinoma.

**A.** Plain radiograph shows the osteolytic bone destruction in the proximal phalanx of the right index with sunburst periosteal reaction.

**B, C.** Coronal T1-weighted spin-echo and coronal T2-weighted fast spin-echo MR images demonstrate an extensive lesion occupying almost entire proximal phalanx with soft tissue component extending from the medullary space. The masses were iso-intense on T1-weighted images as compared with muscle and heterogeneously hyperintense on T2-weighted images as compared with fat.

**D.** Gadolinium-enhanced coronal T1-weighted spin-echo MR image obtained with fat saturation shows the homogenous enhancement of the entire lesion without a central necrotic portion.

0.4% (12). Bloom (3)

20% (9, 15)

(14/70)

1 1 8

가

가

Milch (13)

Bloom (3)

가 6 , 가 3

가

가 (2).

(1 - 3).

(14). (5) 152

6  
1

(tubular bone)

CT가

6 MRI 가 T1  
MRI  
, T2

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## Metastatic Bone Tumors with Sunburst Periosteal Reaction<sup>1</sup>

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**Purpose:** The purpose of this study was to describe the clinical and imaging features of metastatic bone tumors with sunburst periosteal reaction and to define the characteristic findings which would be helpful for differentiating metastatic bone tumors from primary malignant bone tumors.

**Materials and Methods:** The authors retrospectively reviewed the cases of nine patients with pathologically confirmed metastatic bone tumors with sunburst periosteal reaction, for which imaging studies (plain radiographs [ $n=9$ ], radioisotope [RI] scans [ $n=4$ ], magnetic resonance [MR] images [ $n=6$ ], and computed tomographic [CT] scans [ $n=4$ ]) were performed. The imaging studies of each lesion were analyzed by two musculoskeletal radiologists focusing on the metastatic site, patterns of bone response, signal intensity characteristics and pattern of contrast enhancement on MR. The clinical records of the patients were reviewed with regard to the age and sex of the subjects, the clinical presentation, and the origin of the primary tumors.

**Results:** The cases consisted of six men and three women, whose mean age was 62 years (age range, 50 - 88 years). The primary tumors were adenocarcinoma of the stomach [ $n=4$ ], adenocarcinoma of the lung [ $n=2$ ], adenocarcinoma of the prostate [ $n=1$ ], hepatocellular carcinoma of the liver [ $n=1$ ], and adenocarcinoma of unknown origin [ $n=1$ ]. The sites of metastatic involvement exhibiting sunburst periosteal reaction were the scapula [ $n=2$ ], proximal humerus [ $n=2$ ], rib [ $n=1$ ], iliac bone [ $n=1$ ], tibia [ $n=1$ ], spine [ $n=1$ ], and proximal phalanx [ $n=1$ ]. In all patients, the imaging findings showed osteolytic [ $n=3$ ] or osteoblastic [ $n=6$ ] lesions with sunburst periosteal reaction. In six cases, the lesions were iso-intense on the T1-weighted images and heterogeneously hyperintense on the T2-weighted images. The gadolinium-enhanced T1-weighted images showed a nearly homogenous enhancement of the lesions without any central necrotic portion.

**Conclusion:** Although metastatic bone tumor exhibiting sunburst periosteal reaction is rare, it should be included along with primary malignant bone tumors in the differential diagnosis of bone lesions with sunburst periosteal reaction, especially in older patients with or without a known primary malignancy.

**Index words :** Bone neoplasms, diagnosis  
Bone neoplasms, secondary