

Breast Cancer: Prognostication Based on Pattern of Bone Metastases as seen on Axial Skeleton MRI

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Purpose: Patients with bone metastases from breast cancer have considerable variability in both morbidity and mortality outcomes. Currently we are not aware of any study detailing the use of axial skeleton Magnetic Resonance Imaging (MRI) for obtaining prognostic information with respect to these patients' survival. MRI has shown to be more sensitive than radionuclide bone scanning for detecting bone metastases.^{1,2} We hypothesize that different patterns of axial skeleton metastases on T1-weighted spin-echo MRI will be associated with different lengths of survival for patients with metastatic breast cancer.

Methods: This study was approved by our institution's ethics review board. A retrospective review was conducted on deceased patients with histologically proven breast cancer and an MRI of the axial skeleton showing skeletal metastases. Imaging studies were identified over a three-year period. The axial and proximal appendicular skeleton was divided into the cervical spine, thoracic spine, lumbo-sacral spine, pelvis, femurs, shoulder girdles (including scapulae, clavicles, ribs, humeri) and sternum. Metastatic involvement as seen on T1-weighted MR imaging was documented for each region. The number of patients with involvement of each region was tallied, and the mean length of survival was calculated.

Results: 109 patients met the inclusion criteria. The mean survival time after MRI for all patients was 32 ± 22 months. The table below shows the number of patients with metastases in each of the pre-defined skeletal regions, as well as the mean survival following the MRI based on region of metastatic involvement. Patients with more than 20 metastases had a mean survival of 29 ± 20 months. Patients with diffuse marrow replacement had a mean survival of 22 ± 16 months. The figure below demonstrates an example of the standard images used for analysis in one study patient.

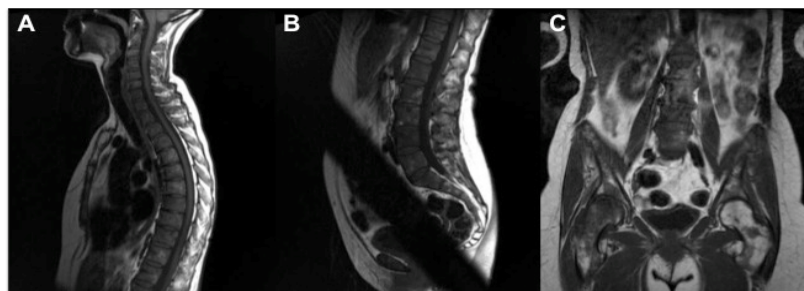


Figure. 61 year-old female with invasive lobular carcinoma. T1-weighted MRI demonstrating diffuse marrow replacement by metastases. **A.** Sagittal image of the cervical and thoracic spine. **B.** Sagittal image of the lumbo-sacral spine. **C.** Coronal image of the abdomen and pelvis demonstrating right femoral head avascular necrosis.

Discussion: Patients with diffuse marrow replacement had the shortest mean length of survival. Those with cervical spine involvement had a poorer mean length of survival than those with other regions of skeletal involvement. A previous publication showed that patients with skeletal metastases caudal to the lumbo-sacral junction on bone scans had a significantly shorter length of survival as opposed to those without.³ We found that patients with pelvis metastases lived longer than those with other regions of involvement not previously studied.

Conclusion: The average length of survival for patients with breast cancer metastatic to bone varies depending on the involved skeletal region on T1-weighted MRI. Further research detailing how the distribution and pattern of skeletal metastases affects prognosis is needed.

Target Audience
 MSK Radiologists, Radiation Oncologists, Medical Oncologists

Skeletal region with metastases	Number of patients (%)	Mean survival (months ± SD)
Cervical spine	57 (52)	27 ± 17
Thoracic spine	93 (85)	30 ± 19
Lumbo-sacral spine	91 (83)	32 ± 20
Pelvis	93 (85)	33 ± 21
Femurs	65 (60)	30 ± 20
Shoulder girdles (including scapulae, clavicles, ribs, humeri)	71 (65)	28 ± 20
Sternum/manubrium	53 (49)	28 ± 18

Table. Number of patients and mean survival grouped by region of metastatic involvement.

References 1. Liu T et al. Skel Rad 2011;40:523-31. 2. Yilmaz M et al. Med Onc 2008;25:257-63. 3. Yamashita K et al. Clin Ortho 1995(312):89-94.