

## REVIEW OF MALIGNANT AND BENIGN FINDINGS OF COMPRESSION VERTEBRAL FRACTURES ON MRI

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### Abstract

The aim of this review is to establish the correct diagnosis of malignant and benign compression vertebral fractures by MRI to determine treatment and prognosis.

Over 5 months period all the MRI examination of fractured vertebrae reported by the radiology department at KHMC were reviewed. Data collected for examination include MRI conventional T1W, T2W spin echo sequences and fast spin echo with STIR (short inversion recovery) sequences. All the cases selected were given intravenous gadolinium contrast medium. Evaluation of the compressed vertebrae includes children and adults, males and females of different ages.

Certain criteria are used to differentiate between benign and malignant collapsed vertebrae on MRI based on the signal intensity, morphology and pattern of contrast enhancement for correct diagnosis.

In conclusion, homogenous and diffuse abnormal signal intensity, posterior convexity and involvement of the pedicles are signs that are strongly suggestive of malignant vertebral compression; conversely, a band-like area of low signal intensity adjacent to the depressed endplate or preservation of signal intensity of the vertebra suggests benign nature of the collapse.

### Introduction

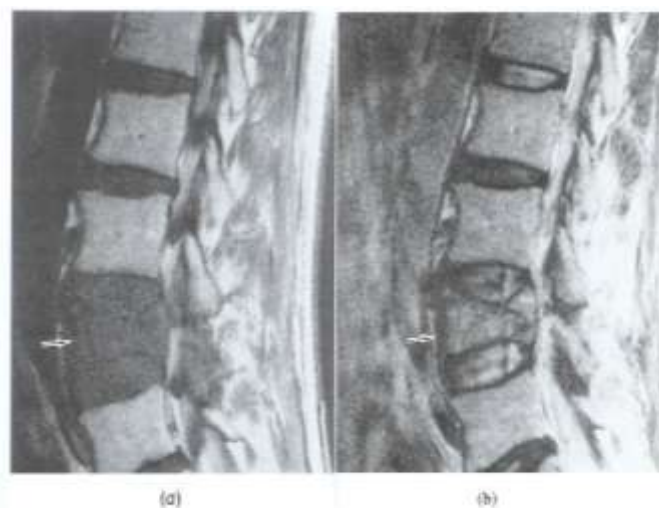
Differentiation between malignant (pathological) and benign vertebral compression fracture is often problematic, this is precisely difficult in elderly who are predisposed to benign compression caused by osteoporosis. Establishing the correct diagnosis is of great importance in determining the treatment and prognosis. In addition to osteoporosis, causes of benign compression fractures include trauma, Langerhans cell histiocytosis, Paget's disease, hemangiomas...etc. Malignant compression fracture can be either metastasis or primary bone tumor, multiple myeloma, malignant lymphoma, leukemia,...etc. Conventional x-ray, bone scintigraphy and

computed tomography have been used for the diagnostic worked up of patient with compression fracture. Recently, MRI is increasingly used for evaluation of these fractures.

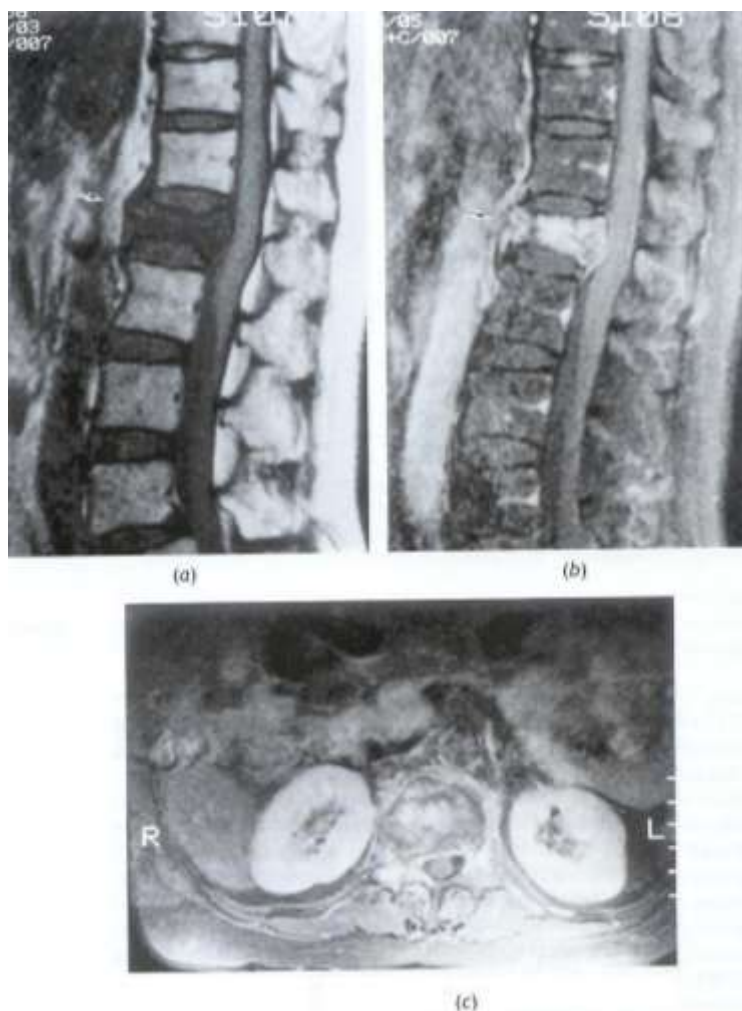
#### Criteria for Malignant Compression fractures

On T1 weighted images a malignant compression fracture shows complete replacement of normal bone marrow with low signal intensity in the whole vertebral body (fig1). On T2weighted images iso to high signal intensity is seen in the collapsed vertebra (fig2) the distribution of signal intensity can be either homogenous or heterogeneous. Abnormal enhancement is seen in the vertebrae on post-contrast medium enhanced images particularly those obtained after fat suppression technique. Enhancement is usually inhomogeneous in the diffuse or patchy distribution<sup>1</sup>.

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**Figure 1:** malignant compression fracture (a) sagittal T1W (400/30) image shows diffuse low signal intensity in the collapsed fourth lumbar vertebra (arrow). (b) Sagittal T2W image (2000/100) shows an inhomogeneous almost isointense signal in the collapsed vertebra (arrow).



**Figure 2:** Malignant compression fracture. (a) Sagittal T1WI (TR/TE 400/30) shows a diffuse low signal in the collapsed first vertebra (arrow). Note convex bulging of post vertebral cortex. (b) Fat-saturated contrast-enhanced sagittal T1WI (500/30) shows abnormal enhancement of the collapsed vertebra (arrow). (c) Para spinal soft tissue mass is seen on the axial post-contrast medium enhanced image (600/20).

Morphological features that are considered to be suggestive of malignant compression fractures include convex bulge involving the whole posterior convexity of the vertebral body (Fig2)<sup>1,2</sup>, involvement of the pedicles (Fig3)<sup>1-4</sup>. The presence of an epidural mass is said to have 80%

sensitivity and 100% specificity for malignant fractures<sup>1</sup>. A convex bulge of the posterior cortex of the vertebrae has sensitivity of 70% and specificity of 94% while involvement of the pedicle is said to have 80% sensitivity and 94% specificity<sup>1</sup>

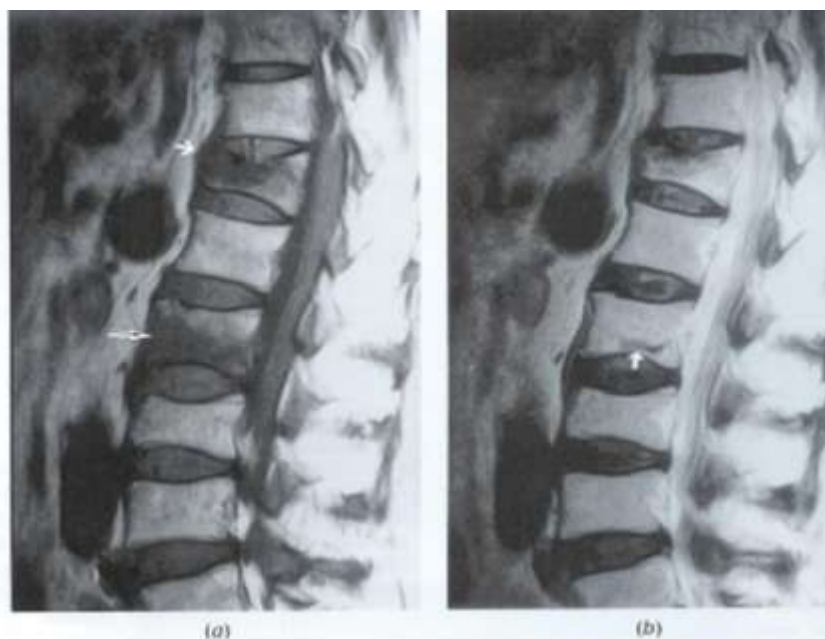


**Figure 3: Malignant compression fracture. Sagittal T1W1 (TR/TE500/200) shows malignant compression fracture involving the body and posterior elements of the eighth thoracic vertebra. Another lesion is seen in the posterior portion of the ninth thoracic vertebra (arrow).**

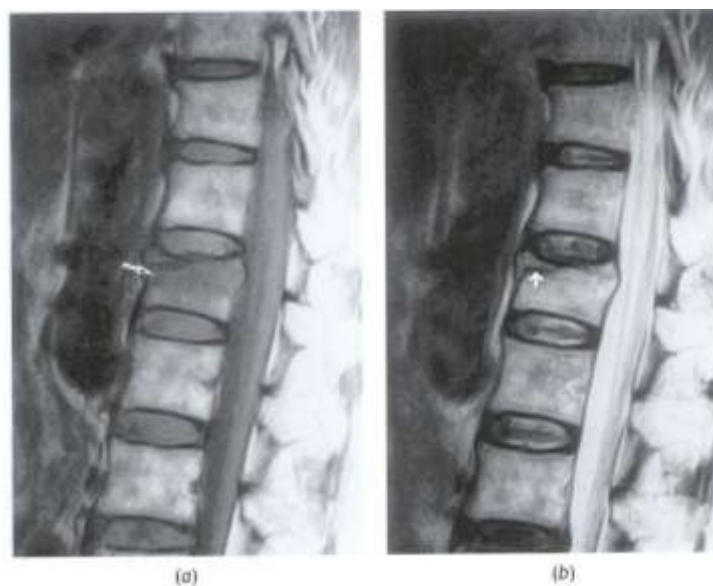
#### Criteria for Benign Compression fracture

Signal intensity of benign compression fracture varies according to the age of the fracture. Osteoporotic fractures of more than two months old, characteristically show focal band like area of low signal intensity adjacent to the fractured endplate (fig 4)<sup>3,4</sup>. At least one area of normal signal intensity is seen within the collapsed vertebra. These areas of normal signal intensity are normally located opposite the fractured endplate and can have variable shapes...<sup>1</sup>. On T2weighted images a collapsed vertebra is essentially isointense with adjacent non-collapsed

vertebrae (Fig4)<sup>1</sup>. An area of low signal corresponding to the fracture line or trabecular impaction can also be seen on T2 weighted images (Fig 5)<sup>5-7</sup>. On post contrast T1weighted images, there is partial or complete equalization of the signal intensity of the collapsed vertebrae with that of the adjacent non-collapsed vertebrae<sup>1</sup>. The presence of focal, linear or triangular areas of high signal intensity (fluid sign) adjacent to vertebral endplate on short inversion recovery STIR image is said to be fracture due to acute and sub-acute osteoporosis, and is rarely seen in metastasis fracture<sup>8</sup>.



**Figure 4: Acute benign compression fractures. (a) Sagittal T1W1 (TR/TE 560/22) endplate. Also note acute collapse of the 2th thoracic vertebra (white arrow) within area of normal bone marrow posteriorly. (b) On sagittal T2W1 (2000/100) both the vertebrae are almost isointense with the adjacent normal vertebrae. Linear area of low signal in the body of second lumbar vertebra (white arrow) probably represents a fracture line or trabecular impaction.**



**Figure 5: Acute benign compression fracture. (a) Sagittal T1W1 (TR/TE 500/22) shows low signal intensity of the fractured vertebra (black arrow). (b) ON sagittal T2W1 (3600/98) bone marrow signal of fractured vertebra is isointense to adjacent normal vertebra. The low signal intensity area adjacent to superior endplate is probably a fracture line (white arrow).**

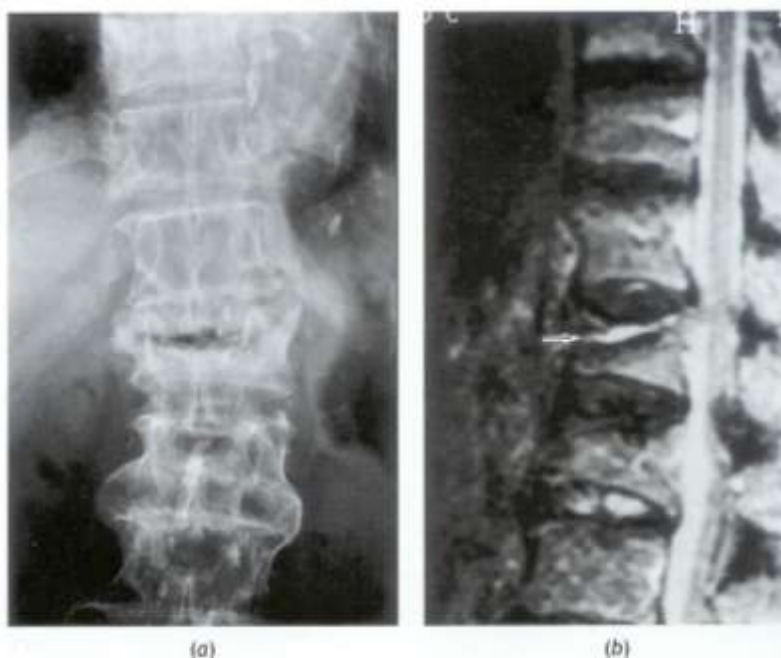


**Figure 6: Chronic Benign compression fracture. Sagittal T1W1 (TR/TE/560/22) shows preservation of normal bone arrow in multiple collapsed vertebrae.**

Retropulsion of a posterior fragment (often postero-superior) is one of the morphological features and highly specific 100% for benign fracture (Fig 5)<sup>1</sup>. Chronic benign osteoporosis fractures usually show normal signal

intensity of the vertebral body on both T1weighted and T2 weighted images (Figure 6).

A vacuum cleft in a collapsed vertebra is indicative of avascular necrosis and is suggestive of benign etiology. (Fig 7)<sup>9</sup>.



**Figure 7: benign compression fracture with vacuum cleft. (a) Anteroposterior radiograph of lumbar spine shows gas collection in the collapsed first lumbar vertebra. (b) Sagittal T2W1 (TR/TE 2500/100) shows a linear area of high signal intensity (arrow) within the collapsed vertebra corresponding to fluid replacing the gas within the vacuum cleft.**

It is not rare to see both benign and malignant compression fractures in the same patient with multiple collapsed vertebra. Hence, the morphological and

signal intensity criteria should be applied to each collapsed vertebrae separately. However, MRI features help in the differentiation of malignant and

benign compression fractures in the majority of cases. If initial MRI findings are equivocal, correlation with other imaging techniques, follow up and biopsy in selected cases are helpful in reaching the correct diagnosis.

In conclusion, homogenous and diffuse abnormal signal intensity, posterior convexity, and involvement of pedicles are signs that are strongly suggestive of malignant compression fractures. Conversely, a band like area of low signal intensity adjacent to the depressed endplate or preservation of

signal intensity of the vertebra suggests benign nature of the collapse. By applying the constellation of morphological and signal intensity criteria, the nature of the majority of compression fractures can be correctly predicted with a high degree of certainty. However, when MRI features are atypical or equivocal, correlation with other imaging techniques, short interval follow up, MRI examination and biopsy, may be needed to provide the correct diagnosis.

## References

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