# Implementing a Structured MRI Protocol for Bone Tumour Imaging: A Practical, Evidence-Based Approach

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## BONE TUMORS

Place specific demands on imaging: the central question is whether a lesion is **benign** or **malignant**, and the answer determines whether a patient proceeds to **biopsy**, **active surveillance**, or **reassurance**.

- **Conventional radiography** is the obligatory starting point and must always be correlated with MRI — plain films provide irreplaceable information on **matrix mineralisation, periosteal reaction**, and **zone of transition.**
- **MRI** is the modality of choice for **local staging**, **tissue characterisation**, and **treatment monitoring**.

| THE CORE MRI PROTOCOL | |
|---|---|
| **coronal or sagittal T1-weighted spin-echo** | • assessment of marrow signal<br>• intramedullary tumour extent<br>• intralesional fat or haemorrhage<br>• the most accurate sequence for determining true tumour margin |
| **axial and coronal T2-weighted fast spin-echo (FSE/TSE) with fat suppression** | • lesion characterisation<br>• soft-tissue involvement |
| **Dixon-based fat suppression** | • homogeneous signal suppression<br>• yields fat-only and water-only images from a single acquisition |
| **axial diffusion-weighted imaging (DWI) with ADC maps** | • quantification of tumour cellularity<br>• treatment response monitoring |
| **post-contrast fat-suppressed T1-weighted spin-echo in at least two orthogonal planes** | • identification of viable, vascularised tumour tissue to guide biopsy<br>• distinction of solid from cystic components |
| **EXTENDED PROTOCOL** | |
| **dynamic contrast-enhanced MRI (DCE-MRI)** | • functional assessment of tumour perfusion and<br>• monitoring of response to neoadjuvant chemotherapy |

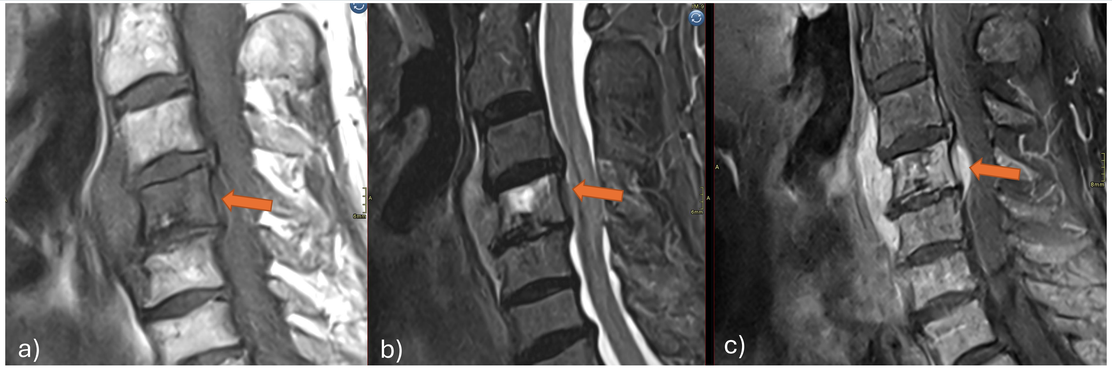


**Figure 1:** Patient no. 1. Cervical spine MRI demonstrating pathologic infiltration of the C4 vertebral body. Sagittal planes**. a) T1-weighted sequence:** hypointense signal in the C4 vertebral body with an associated soft tissue component**. b) T2 STIR sequence:** hyperintense signal in the upper half of the C4 vertebral body. **c) T1-weighted fat-suppressed sequence after contrast administration:** contrast enhancement of the pathologic infiltration of the C4 vertebral body and the extraosseous tumor component at the C4 and C5 levels.

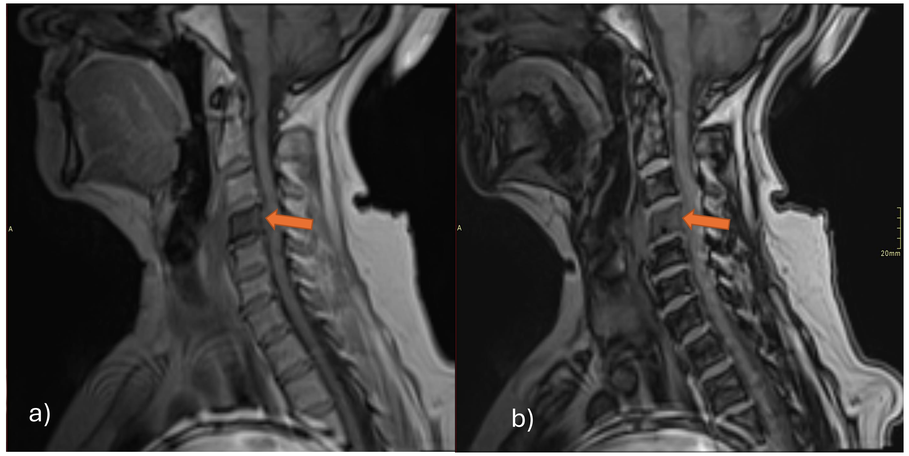


**Figure 2:** Patient no. 1. Cervical spine MRI using the Dixon technique, sagittal planes. **a) In-phase sequence:** low signal intensity in the affected vertebral body due to the absence of fat signal. **b) Out-of-phase sequence:** in the absence of intralesional fat, signal cancellation does not occur, resulting in a hyperintense signal. These abnormal signal characteristics are consistent with malignant infiltration of the bone marrow.

## MALIGNANT LESIONS

Consistently demonstrate **restricted diffusion with lower ADC values** than benign lesions, enabling **non-invasive characterisation** and **reducing the need for unnecessary biopsy.**

- Serial ADC measurements serve as a **reliable biomarker of treatment response**, making DWI equally valuable at follow-up.
- T1 marrow signal varies with **age** and **metabolic status** and must be accounted for in interpretation.

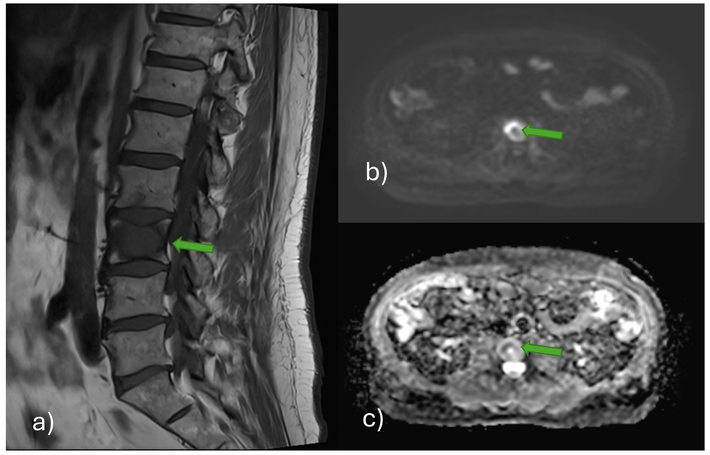


**Figure 3:** Patient no. 2. MRI of the lumbosacral spine. **(a) Sagittal T1-weighted sequence:** hypointense signal in the L3 vertebral body. **(b) Axial diffusion-weighted imaging (DWI):** hyperintense signal in the right anterior aspect of the L3 vertebral body. **(c) Axial apparent diffusion coefficient (ADC) map:** hypointense signal in the right anterior aspect of the L3 vertebral body. These abnormal signal characteristics are consistent with malignant infiltration of the bone marrow.

This structured protocol , always interpreted alongside radiographs — provides a reproducible framework for **diagnostic characterisation**, **biopsy planning**, **surgical staging**, and **follow-up**.