Optimising Iterative Metal Artefact Reduction (iMAR) in Clinical Practice: Practical Strategies for the Reporting Radiologist

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Introduction & Objective

Metallic implants cause significant beam-hardening and photon-starvation artefacts on CT, obscuring critical diagnostic information. While vendor-specific iMAR algorithms are effective, bone-specific iMAR reconstructions are not always readily available.

Materials & Methods

Study Design: Retrospective case series analysis.
Subjects: 20 lower-limb CT studies with metallic hip/knee implants.
Platform: GE PACS (Centricity™ v6.0).

Evaluation:

A musculoskeletal-trained radiologist assessed bone-prosthesis interface clarity using a 3-point scale (Improvement / Equivocal / Worsening).

Two practical workflow solutions:

1. PACS-Based Optimisation of Soft-Tissue iMAR, applied to studies with soft-tissue iMAR kernels (Br38-40).
Tools Used:
Bone Windowing: W: 2000–2500 HU / L: 400–500 HU.
Sharpening Filter: "Sharpen" tool within PACS.

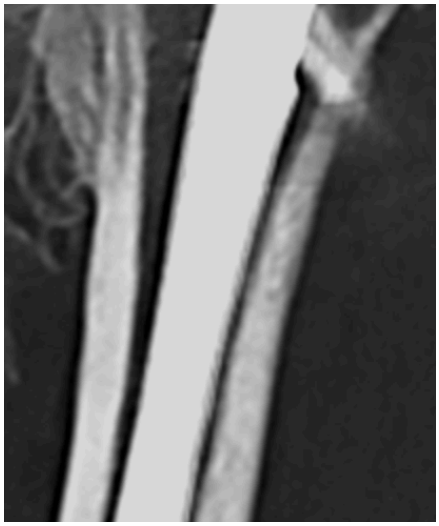
2. Raw Data Reprocessing to enable iMAR, applied to studies initially reconstructed with a standard bone kernel without iMAR (Br60).
Procedure: Archived raw data was retrieved and reprocessed to Br59 kernel + iMAR.

Illustrative Case 1: PACS-Based Optimisation

Clinical Scenario: Post-operative femur (long gamma nail). Only soft-tissue iMAR (Br40) series was available in PACS.

A. Soft-Tissue iMAR (Br40) with Standard Bone Window

Blurring of bone-prosthesis interface.

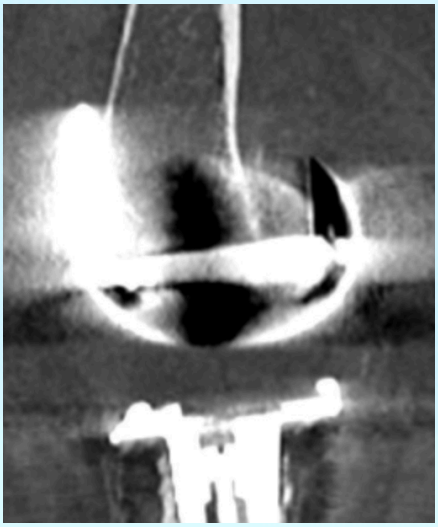


B. Soft-Tissue iMAR (Br40) with Bone Window & Sharpening

Same image as A. Improvement of bone-prosthesis interface visualisation after applying sharpening filter.

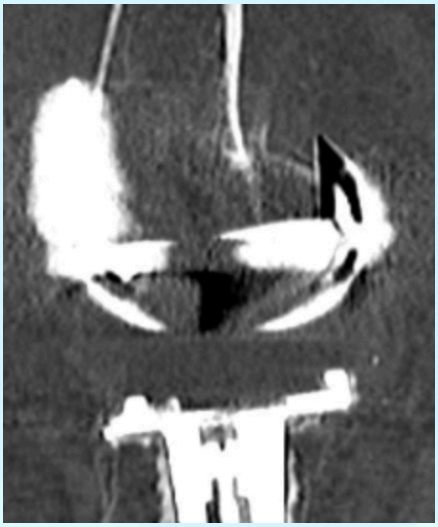
Illustrative Case 2: Raw Data Reprocessing

Clinical Scenario: Suspected periprosthetic fracture in a knee replacement. Initial bone kernel (Br60) was performed without iMAR.



A. Standard Bone Kernel (Br60) - No iMAR

Severe metal artefacts obscuring bone-prosthesis interface, making fracture assessment non-diagnostic.



B. Reprocessed Bone Kernel (Br59) with iMAR

Raw data from the same acquisition was reprocessed to Br59 + iMAR. Note the reduction in artefacts, improving visualisation of the bone-prosthesis interface.

Results:

1. PACS-based optimisation improved bone-prosthesis visualisation in 100% of applicable cases.
2. Raw data reprocessing successfully enabled iMAR application, providing superior artefact reduction compared to the standard bone kernel.
3. Both methods prevented the need for repeat patient scans, enhancing patient safety and workflow

Discussion & Limitations

1. Limited Cohort: The findings are based on a relatively small sample size of 20 cases.
2. Subjective Image Assessment: The evaluation of bone-prosthesis interface clarity was performed by a single, musculoskeletal-trained radiologist without independent validation.
3. Diagnostic Accuracy: The study primarily assessed the improvement in image visualisation. It has not been established whether this enhanced visualisation translates to improved diagnostic accuracy for detecting pathologic abnormalities, such as loosening, infection, or fracture.

Conclusion:

When bone-specific iMAR is inaccessible, (1) PACS-based bone windowing/sharpening of soft-tissue iMAR and (2) raw data reprocessing to Br59 + iMAR provide effective metal artefact reduction and improved bone edge/metal-interface visualisation enhancement. Proactive communication with radiographers remains essential for continuous scanning protocol optimisation.