GLOBAL MRI ACADEMY

MRI Protocol Handbook

Positioning • Coil Selection • Slice Planning • Sequences • Contrast • Image Quality

A practical reference for MRI students, technologists, and ARRT/ARMRIT exam preparation.

1. MRI Exam Setup & Safety

Before scanning, verify the order, patient identity, clinical indication, relevant history, prior imaging when available, and requested body region. Complete the facility's MRI safety screening before the patient enters the controlled MRI environment.

• **Zones:** Zone I is public access; Zone II is the interface/screening area; Zone III is controlled access; Zone IV is the scanner room.

• **Implants and devices:** Determine MR Safe, MR Conditional, or MR Unsafe status using reliable device information. Do not assume compatibility.

• **Projectile prevention:** Keep ferromagnetic objects out of Zone IV. Screen patients, staff, and equipment carefully.

• **RF/thermal safety:** Prevent skin-to-skin contact and conductive loops; use appropriate padding and position cables according to facility policy.

• **Hearing protection:** Provide appropriate hearing protection and explain the importance of keeping it in place.

• **Emergency readiness:** Know emergency stop/quench procedures and follow facility policy. Remove the patient from the magnet room before using equipment that is not MR compatible.

2. General Positioning & Coil Selection

Exam region	Typical position	Common coil choice
Brain	Supine, head centered	Head/brain coil
Cervical spine	Supine, head/neck centered	Spine/neck array
Thoracic/Lumbar spine	Supine, spine centered	Spine array
Knee	Supine, knee centered; slight flexion as protocol allows	Dedicated knee coil
Shoulder	Supine or other facility-approved position	Dedicated shoulder coil
Wrist/Hand	Positioned in dedicated extremity coil	Wrist/hand coil
Abdomen	Supine, arms positioned per protocol	Anterior/posterior body array
Pelvis	Supine, pelvis centered	Pelvic/body array

3. Core MRI Sequence Selection

Sequence / weighting	Primary use	Key planning idea
T1-weighted	Anatomy, marrow, fat, post-contrast assessment	Good anatomic detail; fat is relatively bright
T2-weighted	Fluid, edema, inflammation, pathology	Fluid is relatively bright
STIR	Fat suppression and edema detection	Useful when uniform fat suppression is needed; generally not used after gadolinium for post-contrast T1 assessment
T2 FLAIR	Brain pathology with CSF suppression	Highlights many parenchymal lesions while suppressing CSF
DWI/ADC	Restricted diffusion assessment	Interpret DWI with ADC; common in acute stroke evaluation
GRE/SWI	Susceptibility, blood products, calcification/venous structures	Sensitive to magnetic susceptibility
PD	High-detail MSK assessment	Useful for cartilage, menisci, ligaments, and tendons
Fat-sat T1	Post-contrast anatomy/pathology	Enhances lesion conspicuity while suppressing fat

4. Brain MRI Protocol — Practical Framework

• Center the head carefully and minimize rotation. Use a dedicated head coil when available.

• Plan axial images parallel to an established neuroanatomic reference plane according to the local protocol.

• Common core series may include sagittal T1, axial T2, axial FLAIR, DWI with ADC, and susceptibility-sensitive imaging.

• For suspected stroke, prioritize rapid DWI/ADC and vascular/perfusion sequences when ordered and available.

• For tumor, infection, or inflammatory disease, pre- and post-contrast T1-weighted imaging may be added according to the clinical indication.

• Check whole-brain coverage, motion, fat suppression where applicable, and symmetry before releasing the exam.

5. Spine MRI Protocol

Cervical spine: Typical planning includes sagittal T1/T2 and axial images through relevant levels. Include appropriate coverage of discs, canal, neural foramina, and surrounding soft tissues.

Thoracic spine: Use sagittal T1/T2 as core anatomy series, with axial imaging through areas of interest or per routine protocol.

Lumbar spine: Sagittal T1/T2 (and fat-suppressed fluid-sensitive imaging when indicated) plus axial imaging through disc levels. Align axial slices to the disc spaces according to local protocol.

For suspected infection, tumor, postoperative change, or inflammatory disease, contrast-enhanced imaging may be appropriate when ordered.

6. Knee MRI Protocol

• Use a dedicated knee coil and center the joint carefully. Avoid unnecessary rotation.

• Typical planes include sagittal, coronal, and axial imaging.

• Common sequences include PD/T2-weighted fluid-sensitive fat-suppressed imaging plus a non-fat-suppressed T1 or PD sequence according to local protocol.

• Evaluate menisci, ACL/PCL, collateral ligaments, cartilage, marrow, tendons, muscles, synovium, and joint fluid.

• For cartilage or subtle pathology, use high-resolution imaging with appropriate slice thickness and small field of view.

7. Shoulder MRI Protocol

• Use a dedicated shoulder coil and position the shoulder consistently with the facility protocol.

• Typical planes are axial, oblique coronal, and oblique sagittal.

• Plan oblique coronal images parallel to the supraspinatus tendon/acromion reference used by the protocol; plan oblique sagittal images perpendicular to that plane.

• Use fluid-sensitive fat-suppressed sequences to assess rotator cuff, labrum, marrow, and joint fluid.

• MR arthrography is a separate protocol and requires appropriate contrast preparation and sterile technique.

8. Wrist, Hand, Ankle & Foot

• Use the smallest practical dedicated coil and a small field of view for high spatial resolution.

• Acquire orthogonal planes appropriate to the anatomy and clinical question.

• Use fluid-sensitive fat-suppressed sequences for edema, tendon, ligament, and cartilage assessment.

• Include T1-weighted anatomy when marrow characterization or anatomic detail is important.

9. Abdominal MRI Protocol

• Use a phased-array body coil and center the region of interest accurately.

• Breath-hold or respiratory-triggered techniques may be used according to the scanner and patient capability.

• Common components include axial/coronal T2-weighted imaging, T1-weighted imaging, and diffusion-weighted imaging.

• Dynamic contrast-enhanced T1-weighted imaging may be used for liver, pancreas, kidneys, or other indications when contrast is ordered.

• For liver studies, protocol timing is critical; follow the facility's contrast timing and multiphasic acquisition requirements.

10. Pelvis MRI Protocol

• Center the pelvis and use an appropriate pelvic/body array.

• Common imaging includes axial and sagittal T2, coronal T2 or T1 as indicated, and diffusion-weighted imaging.

• Use small field of view and thin slices when detailed pelvic anatomy is required.

• Post-contrast fat-suppressed T1-weighted imaging may be added for tumor, infection, inflammatory disease, or other indications.

11. Contrast Administration — Safety Framework

• Confirm the exam indication and whether contrast is actually ordered/required.

• Review the patient's relevant history and prior contrast reactions according to facility policy.

• Assess renal function when required by the facility's current gadolinium policy and the specific contrast agent.

• Verify the correct patient, agent, dose, route, IV patency, and expiration information.

• Monitor the patient and be prepared to respond to an adverse reaction according to emergency policy.

• Document contrast administration accurately.

12. Image Quality & Troubleshooting

Problem	Possible cause	Practical response
Motion artifact	Patient movement, long scan	Explain the exam, improve comfort/immobilization, use faster sequences when appropriate
Poor SNR	Small voxel, low signal, coil/position issue	Optimize coil placement, voxel size, averages, FOV and other protocol parameters
Wrap-around / aliasing	FOV too small relative to anatomy	Increase FOV, use phase oversampling, or change phase direction
Chemical shift	Frequency difference between fat and water	Use appropriate bandwidth, fat suppression, or parameter adjustment
Susceptibility artifact	Metal, air-tissue interfaces, field inhomogeneity	Change sequence/TE when appropriate, increase bandwidth, optimize shimming
Fat-sat failure	Field inhomogeneity or poor positioning	Improve positioning/shimming or use an alternative fat-suppression method
Ghosting	Periodic motion/flow	Reduce motion, change phase direction, use gating/triggering when appropriate

13. Slice Planning Checklist

• Confirm the correct body region and laterality.

• Use three-plane localizers when appropriate.

• Center anatomy in the coil and scanner isocenter as closely as practical.

• Plan slices to cover the entire requested anatomy with appropriate margins.

• Use the smallest practical FOV and appropriate matrix for the clinical task.

• Review slice angulation against relevant anatomic landmarks.

• Confirm coverage before moving to the next sequence.

14. Final Exam Quality Check

• Correct patient and exam verified.

• Correct body part and laterality confirmed.

• Safety screening completed and documented.

• All required sequences acquired with adequate coverage.

• Diagnostic anatomy is included and not unnecessarily cropped.

• Motion and artifacts are acceptable or appropriately repeated.

• Contrast information documented when applicable.

• Images reviewed before the patient leaves when feasible, following department policy.

15. Quick Reference: Parameter Concepts

Parameter	General effect
TR	Influences longitudinal recovery and T1 contrast; longer TR generally permits more recovery
TE	Influences transverse decay and T2/T2* weighting; longer TE generally increases T2/T2* sensitivity
FOV	Controls displayed coverage and affects pixel size when matrix is fixed
Matrix	Higher matrix can improve in-plane spatial resolution but may reduce SNR or increase scan time
Slice thickness	Thinner slices improve through-plane resolution but generally reduce SNR
NEX/NSA	Increasing averages improves SNR but increases scan time
Bandwidth	Higher bandwidth can reduce chemical shift and some susceptibility effects but may reduce SNR

Important: Exact parameters (TR, TE, flip angle, slice thickness, FOV, matrix, bandwidth, acceleration, contrast dose/timing, and sequence order) vary by scanner, vendor, field strength, coil, indication, radiologist preference, and institutional protocol. This handbook is an educational framework, not a substitute for an approved clinical protocol.