# A comprehensive guide in Prostate MR Imaging providing an overview of current, advanced techniques, Central Pitfalls and Correction Strategies

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## Introduction

The second most prevalent cause of death among men in Western Europe is prostate cancer, with an incidence above of 200 in each 100,000 males. Currently, several clinical screening methods are employed in order to detect this neoplasm including elevated Prostate Specific Antigen Test (PSA), Digital Rectal Exam (DRE) and Trans-Rectal Ultrasound (TRUS)-Guided Biopsy. However, approximately 35% of prostate cancer is missing when using these examinations. In the last few decades, there has been growing usage of Prostate Magnetic Resonance Imaging (MRI) as a non-invasive high accurate tool in the detection and diagnosis of prostate cancer. MRI is beneficial not only in localization, but also in assessment of lesion aggressiveness, which may overcome the sampling errors related to Transrectal Ultrasound guided prostate biopsy (TRUS) , which usually done to diagnose cancer cells in the prostate gland using ultrasound. Moreover, MRI protocol can be beneficially used in an Active Surveillance which means monitoring patients with low-volume and low-grade prostate cancer while they are under deferred immediate therapy.[3]

In the other hand, pelvic magnetic resonance imaging (MRI) involves many challenges that are not encountered to the same degree in other body regions. Complications that uniquely affect body MRI include physiologic motion from respiratory and bowel motion. By introducing of technical innovations in MRI, such as the development of phased-array coils, high performance gradients, and methods to reduce motion-related artefacts, body imaging can be obtained with excellent contrast resolution in a reasonable scanning time. In order to optimize prostate MR protocols and improve its efficiency, it is essential for the radiographer to be familiar with basic MR imaging principles and able to minimize the effects of motion artefact. Therefore, the purpose of this review is to discuss the prostate MRI technique and address some challenges that may encounter MR radiographers.

## Technical challenges

Bowel motion is reduced by compression and administrating antispasmodic agents IV, IM or subcutaneously prior to the examination. Compression also reduce respiratory motion by encouraging the patients to breathe from their upper abdomen and chest rather than their pelvis. Spatial pre-saturation pulses applied superior and inferior to the field of view reduce flow motion artefact in the IVC, aorta and iliac vessels. Blade technique is a method of filling the k-space in a radial trajectory in which motion-related artefacts can be adjusted. It is used in prostate imaging to minimize motion artefact. Hemorrhage often has low T2 signal intensity, mimicking cancer, and may introduce significant artefact on DWI and 1H-MRSI and confound results from DCE MR imaging. For this reason, an interval of at least 6 weeks between the most recent prostate biopsy and the MRI scan is recommended.

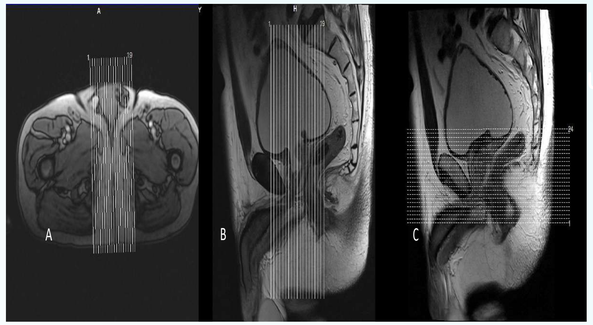



Figure 3 Shows the slice prescription for MRI prostate

Using of high b values requires a strong gradient system that able to switch on and off rapidly. Consequently, this will induce eddy currents, resulting in superimposed magnetic field that cause local field inhomogeneity, and ending with anatomical distortion on DWI. As a result, the distortion will affect the shape, size and position of the prostate, and may obscure focal lesions. In addition, metal implants produce sever distortion artefacts. Rectal distention with stool or gas may distort the DWI. To minimize distortion artefacts, parallel imaging techniques, reduce receiver bandwidth, decrease echo spacing and echo train length and use minimal echo time (TE). In addition, it would be better to apply left-right phase encoding direction rather than anterior-posterior to avoid artefacts from stool or urine.

## Suggested protocol and parameters:

| Sequence | FOV (mm) | Slice Thickness (mm) | Distant Factor (%) | TR (ms) | TE (ms) | Flip Angle | Matrix Size (mm) | Turbo Factor | Scan Time |
|---|---|---|---|---|---|---|---|---|---|
| SAG. T2W--FSE | 270 x 244 | 4 | 10 | 3860 | 103 | 180 | 512 x 255 | 15 | 3.03 |
| AX. T2W-FS | 200 x 200 | 4 | 10 | 4000 | 100 | 180 | 320 x 275 | 15 | 4.16 |
| COR. T2W--FSE | 230 x 208 | 4 | 10 | 3710 | 103 | 180 | 512 x 255 | 15 | 5.17 |
| AX. DWI | 260 x 221 | 4 | 0 | 4000 | 87 | | 160 x 95 | | 4.54 |
| AX. T1W--FSE | 380 x 249 | 4 | 20 | 441 | 10 | 150 | 512 x 252 | 3 | 1.36 |
| AX. 3D VIBE | 259 x 259 | 3.5 | 20 | 4.38 | 1.55 | 15 | 192 x 138 | | 5.13 |

Table 1 Depicts sequence's parameters for MRI prostate protocol.

## Patient preparation, position and slice planning

All Patients with MRI contraindications should be excluded. Patients are usually scanned in the supine position to maximize patient comfort. Foam pads and compression band can be applied across the patient lower pelvis to reduce respiratory and bowel motion. If a local rectal coil is used, it should be carefully inserted prior to the examination with paying attention to be correctly positioned and fully inflated. In order to obtain axial view, the slices should be tilted to be perpendicular to prostatic urethra or peripheral zone on sagittal plane. Coronal slices are placed on the sagittal plane and angled to be parallel to prostatic urethra, the whole prostate and seminal vesicles must be covered to provide coronal images. With regards to Sagittal view slices are planned on the axial and coronal localizers, and placed parallel to prostatic urethra with suitable angulation as needed. They must cover the whole prostate and seminal vesicles (Figure 3)

## Conclusion

To conclude, MRI is vital tool in the assessment interaction of prostate cancer. Moreover, it can be valuable to direct designated biopsy when prostate cancer is clinically suspected and previous ultrasound-guided biopsy results are negative, localize and stage prostate malignant growth and give a guide to therapy arranging and to identify locally repetitive malignant growth after treatment. In order to provide metabolic and practical data that can work on the precision of prostate malignancy location and characterization, the suggested protocol includes T2WI, T1WI, diffusion-weighted imaging (DWI) and contrast-enhanced MRI (CE-MRI).

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