431-02-017 / 431-02-017 ISMRM ABSTRACT

Utilization of 0.55 T for Prostate Imaging in Patients with Hip Prosthesis

PowerPitch Oral · 2 min + **Traditional Poster** · 60 min | A Clearer View Within: Advances in Body Imaging · Tuesday, 12 May, 2:12 PM–2:14 PM · Session: 1:40–3:16 PM · Roof Terrace 〉 **Keywords:** PROSTATE MRI 0.55T METALLIC IMPLANTS SUSCEPTIBILITY-INDUCED GEOMETRIC DISTORTION DIFFUSION-WEIGHTED IMAGING (DWI)

Hero K Hussain [1], **Yun Jiang**[2], **Reve Chahine**[1], **Michael J Jaroszewicz**[1], **Jacob Richardson**[1], **Joel Moorhouse**[1], **Shaun Esch**[1], **Zhengguo Tan**[1], **Vikas Gulani**[1,3,4]

[1]Department of Radiology, University of Michigan, Ann Arbor, United States of America
[2]Departments of Radiology and Biomedical Engineering, University of Michigan, United States of America
[3]Functional MRI Laboratory, Department of Radiology, University of Michigan, Ann Arbor, United States of America
[4]University of Michigan, Ann Arbor, United States of America

Presenting Author: *Hero K Hussain (hhussain@med.umich.edu)*

Impact

Routine 0.55 T MRI enables adequate prostate imaging in patients with hip implants, overcoming severe artifact limitations at 1.5T/3T. This provides a practical diagnostic solution for a growing population unable to benefit from effective MRI-based prostate cancer surveillance and evaluation.

Synopsis

Motivation: Many prostate MRI patients have hip implants, resulting in severe artifacts at 1.5T/3T and non-diagnostic DWI/ADC images, which reduces cancer detection rates.

Goals: Assess 0.55 T MRI performance for prostate imaging in hip implant patients, leveraging lower field strength to address artifact-driven failures at 1.5T/3T.

Approach: Thirty-one patients with hip prostheses underwent 0.55T prostate MRI reviewed by radiologists with varying experience who assigned PI-RADS categories and segmented lesions for targeted biopsy.

Results: All 0.55-T scans were diagnostic, enabling lesion categorization and guided biopsies. Clinically significant cancers, including extracapsular extension, were detected in cases previously considered nondiagnostic at 1.5T/3T.

PURPOSE

To determine the diagnostic performance of 0.55 T MRI for imaging the prostate gland in patients with hip implants in routine clinical practice.

INTRODUCTION

Current diagnostic workflows involve multiparametric MRI performed ideally at 3T according to PI-RADS recommendations (1). However, increasing numbers of patients have metallic hip prostheses and that number is projected to increase (2). Susceptibility artifacts arising from these prostheses compromise prostate MRI quality and cancer detection, particularly by degrading diffusion-weighted imaging (DWI). The underlying echoplanar imaging is prone to susceptibility artifacts, which are exaggerated at higher fields. 3T offers no consistent diagnostic advantage for these patients, while 1.5T slightly reduces artifacts but remains often inadequate (3,4). The result is heavily distorted images at 3T (Figures 1a–b), and still severe at 1.5T (same patient, Figures 1c–d). Large-scale data confirm that moderate-to-severe artifacts lower cancer detection rates by 25%; the limitation is technical and unrelated to image interpretation (5). Because susceptibility effects scale with field strength, reducing to 0.55T should mitigate distortion, potentially improving prostate visibility compared to 3T/1.5T, even near metallic implants. Therefore, 0.55-T MRI may represent a technologically and clinically rational pathway to enable reliable prostate imaging in patients with hip prostheses, directly addressing artifact etiology rather than compensating for its consequences. To make such imaging possible, factors such as SNR, imaging time, imaging artifacts, image quality, and diagnostic efficacy must be considered. Here we share initial experience with performing clinical prostate MRI at 0.55T on patients with hip implants.

METHODS

31 consecutive patients with unilateral (n=17) or bilateral (n=14) hip prostheses who underwent prostate MRI on 0.55T between April 2024 and October 2025 were included. All examinations were interpreted in routine practice by nine radiologists with 2–13 years of experience in prostate MRI. The 0.55-T scans were performed either as follow-up to nondiagnostic DWI acquired at 1.5T/3T or de novo. For each study, the size, number, and location of focal prostate lesions were documented, along with modified PI-RADS assessment category and whether the lesion was segmented for targeted biopsy guided by 0.55T images. Histopathology results from targeted or template biopsies, and prostatectomy specimens, were recorded.

RESULTS

31 patients were scanned. 21 had previously undergone at least one nondiagnostic study at 1.5T/3T (1.5 T: 23 scans; 3 T: 5 scans). In all such cases, the DWI was deemed nondiagnostic due to artifact-related distortion (Figure 1a–f).

None of the 0.55 T scans were considered nondiagnostic by any reader, and PI-RADS category X was not assigned to any case. Based on 0.55 T imaging, PI-RADS categorization of prostate lesions was as follows: PI-RADS 2 (15 patients), PI-RADS 3 (2 patients), PI-RADS 4 (9 patients), and PI-RADS 5 (6 patients). 3 patients had multiple lesions: one had three PI-RADS 4, another had 2 PI-RADS 4, and the third had PI-RADS 4 and PI-RADS 3 lesions.

Among the 20 focal lesions categorized as PI-RADS 3 or higher, 10 were in midgland, 6 at base, and 4 at apex. 16 lesions (80%) were in the peripheral and 4 in the transition zone.

Three of six PI-RADS 5 lesions (1.8–2.8 cm) underwent targeted biopsy using segmentation derived from 0.55 T images. Two of three yielded clinically significant prostate cancer (Grade Group (GG) ≥2), including one with suspected extracapsular extension (1.8 cm) confirmed at surgery; one lesion (2.8 cm) was benign. One patient had GG1 disease on prior biopsy, and two are awaiting biopsy.

10/12 PI-RADS 4 lesions in nine patients were biopsied (size range, 0.5–1.4 cm). Among the three lesions biopsied using 0.55T segmentation-guided targeting, one yielded GG2 cancer (0.5 cm), one showed Atypical Small Acinar Proliferation (0.9 cm), and one was benign (1.0 cm). The remaining lesions (0.5–1.6 cm) had prior template biopsies showing GG1 (n = 4), GG2 (n = 2) (Figure 2a–g), and granulomatous prostatitis (n = 1); two lesions are awaiting biopsy.

Of two PI-RADS 3 lesions, one (1.2 cm, subcapsular) yielded GG1 cancer following 0.55T segmentation-guided targeting, and one remains unbiopsied. Among the 15 PI-RADS 2 lesions, template biopsy data were available for 7: 3 had GG2 cancers (including 2 on active surveillance (AS) and 1 identified post-MRI), 3 had GG1 cancers (all on AS), one was benign (biopsied post-MRI), and 8 remained unbiopsied.

DISCUSSION AND CONCLUSION:

Prostate MRI performed at 0.55 T provided diagnostically interpretable images in all patients with unilateral or bilateral hip implants, including those whose prior higher-field scans, particularly DWI, were nondiagnostic due to severe susceptibility artifacts. These findings suggest that 0.55 T MRI represents a viable backup modality for prostate imaging in this challenging patient population.

References

1. American College of Radiology. Prostate Imaging Reporting & Data System (PI-RADS) Version 2.1. 2019. https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/PI-RADS.

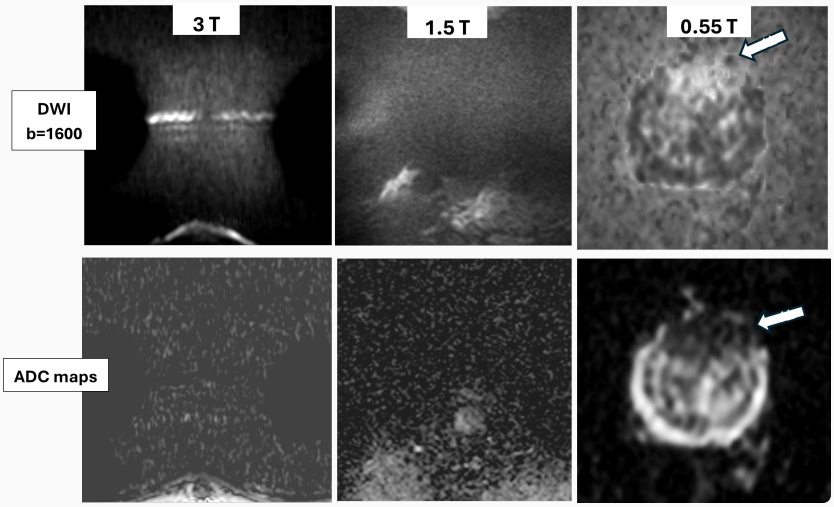
2. Shichman I, et al. Arthroplast Today 2023; 21:101152. PMID: 37293373 [pmid]

3. Boschheidgen M, et al. Eur J Radiol. 2021; 144:109949. PMID: 34537450 [pmid]

4. Nakai H, et al. Abdom Radiol 2024; 49: 3913. PMID: 38980403 [pmid]

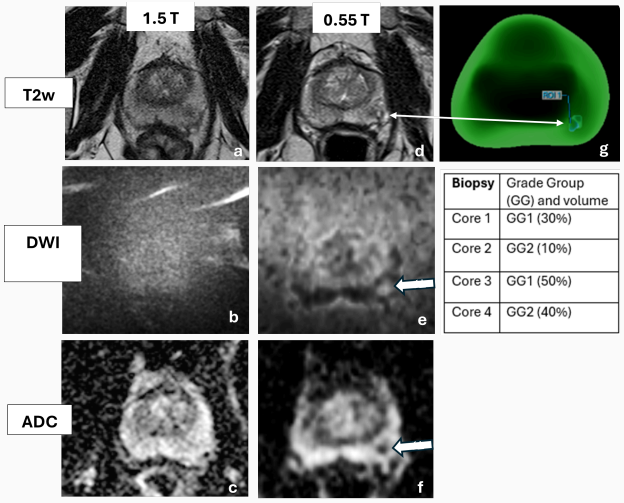
5. Nakai H, et al. Eur Radiol 2024; 34:3387. PMID: 37889268 [pmid]

Figures and Tables



Scan for high-resolution version

Figure 1: Figure 1 (a-f): *Diffusion-weighted images (DWI) and apparent diffusion coefficient (ADC) maps from a prostate MRI in a patient with bilateral hip prostheses performed at 3 T (a,b), 1.5 T (c,d), and 0.55 T (e,f). A large tumor in the anterior transition zone (white arrows) is clearly visualized at 0.55 T but is not identifiable on DWI and ADC maps acquired at 3 T and 1.5 T due to extensive distortion and susceptibility artifacts from the prostheses.*



Biopsy	Grade Group (GG) and volume
Core 1	GG1 (30%)
Core 2	GG2 (10%)
Core 3	GG1 (50%)
Core 4	GG2 (40%)

Scan for high-resolution version

Figure 2: Figure 2 (a-g): *T2-weighted (T2w), DWI and ADC maps from a prostate MRI in a patient with bilateral hip prostheses at 1.5 T (a–c) and 0.55 T (d–f). A small posterior mid-gland peripheral zone tumor (white arrows) is seen on DWI (2e) and ADC (2f) collected at 0.55 T but not on corresponding images acquired at 1.5 T due to susceptibility artifact. Segmentation used the 0.55T T2w image and shown in a 3-D model (2g). Targeted biopsy confirmed clinically significant prostate cancer (table below).*

Table 1: Details of the 35 lesions detected in 31 patients who underwent 0.55T prostate MRI

PI-RADS Category	No. of lesions	Biopsied	Size (cm) Range	Targeting/Imaging Modality	Biopsy Result(s)	Awaiting Biopsy
5	6	3	1.8–2.8	0.55T segmentation-guided targeted biopsy	GG3 (n=1), GG2 (n=1), Benign (n=1)	2
				Prior biopsy	GG1 (n=1)	
4	12	10	0.5–1.4	0.55T segmentation-guided targeted biopsy	GG2 (n=1, Figure 2), ASAP (n=1), Benign (n=1)	2
				Prior template biopsy	GG1 (n=4), GG2 (n=2), granulomatous prostatitis (n=1)	
3	2	1	1.2	0.55T segmentation-guided targeted biopsy	GG1 (n=1)	1
2	15	12	--	Template biopsy*	GG2 (n=3; two AS, one post MRI), GG1 (n=3, AS), Benign (n=1, post MRI)	8

* Five pre-MRI, two post-MRI.
Abbreviations: GG = Grade Group, ASAP = Atypical Small Acinar Proliferation, AS = active surveillance.

Scan for high-resolution version

Figure 3: *Table 1: Details of the 35 prostate lesions detected in 31 patients who underwent prostate MRI at 0.55T*