

# Prostate MRI: Ready for primetime?

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# Outline

- Anatomy
- Basics of the sequences
- Need for rectal coil?
- Basics of reading prostate MRI
- Mimics of prostate cancer/Ddx
- PIRADS
- Reader certification?

# Multi-parametric prostate MRI

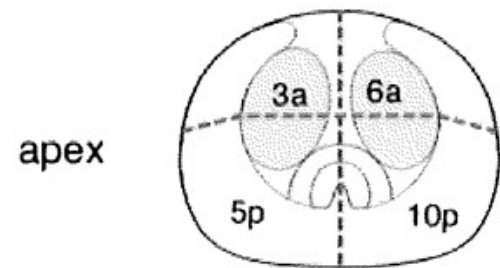
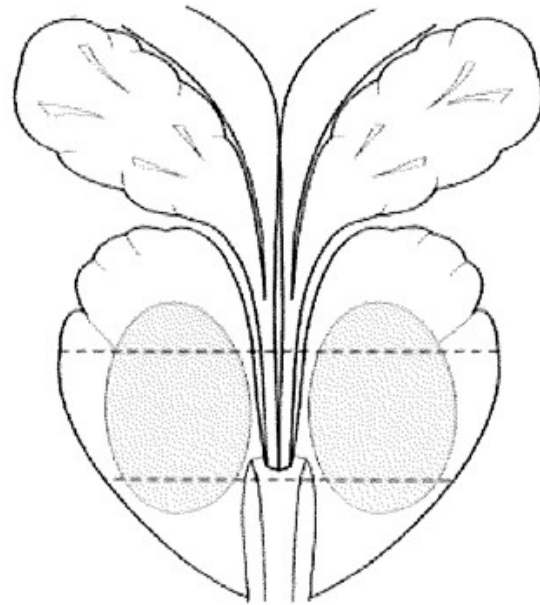
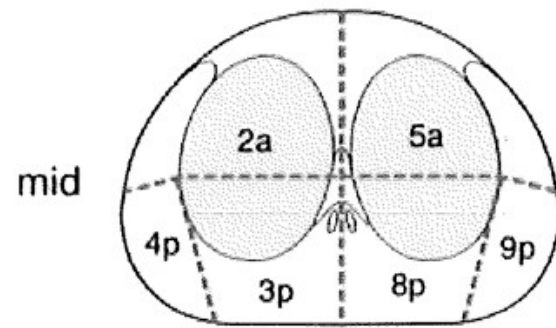
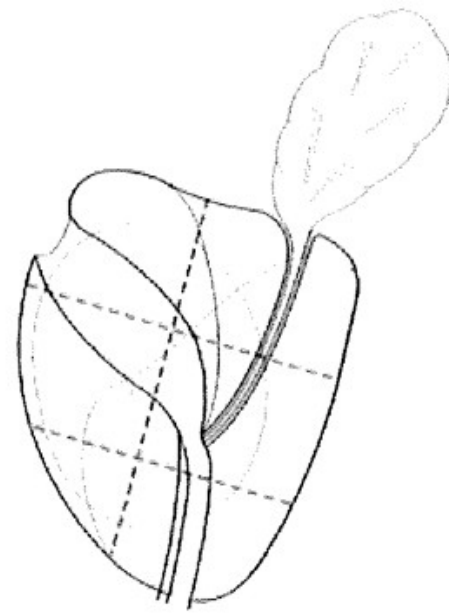
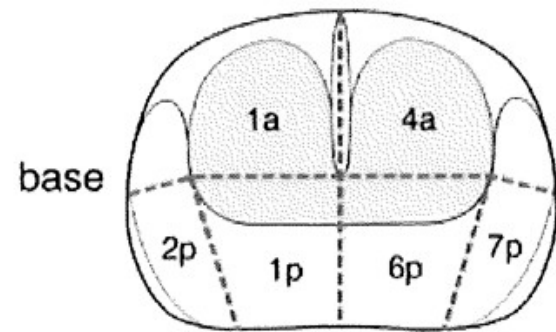
- Most commonly diagnosed cancer in males
  - Second leading cause of cancer-related death in men
- Accurate assessment of the prostate cancer is essential to management
- Initial role of MRI: Locoregional staging in biopsy proven cancer
- New role MRI: Helpful in localization and staging
  - Good sensitivity, 75%
  - Good NPV for exclusion of prostate cancer, 68%-95%

# Multi-parametric prostate MRI

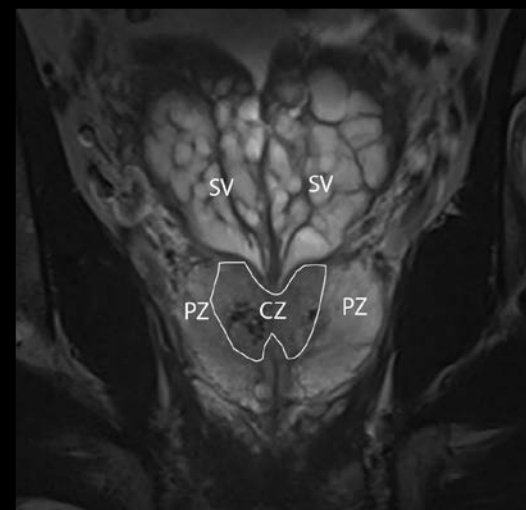
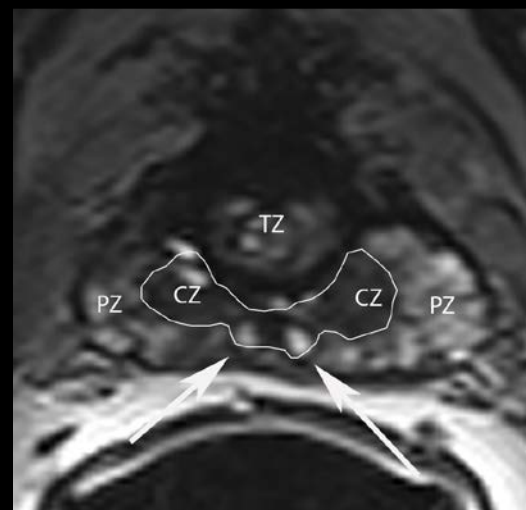
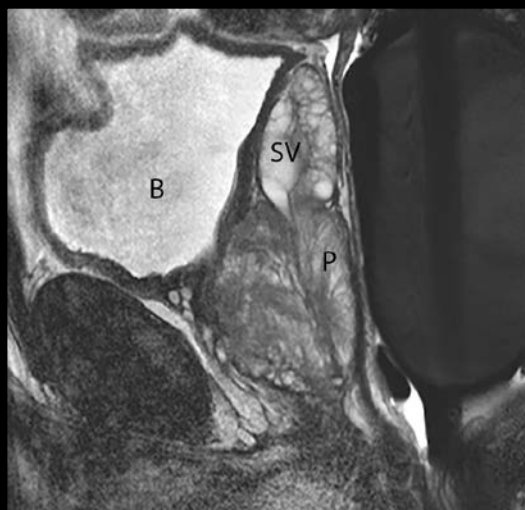
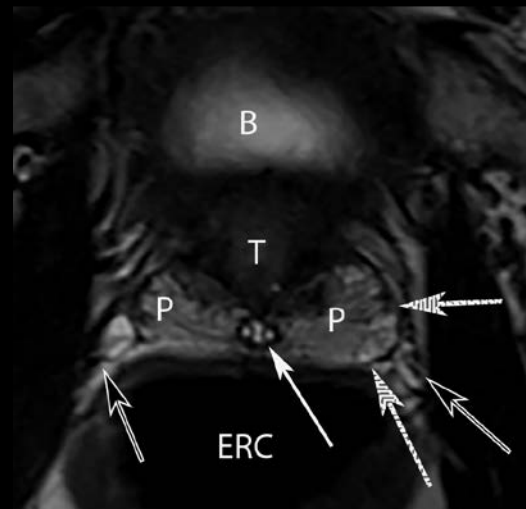
**TABLE 3: Sensitivities and Positive Predictive Values (PPVs) of MRI Detection of All Tumors, Tumors  $\geq 1$  cm, Tumors With a Gleason Score of  $\geq 7$ , Index Lesions, and Satellite Lesions**

MRI Detection of	Sensitivity	PPV
All tumors	132/285 (46.3)	132/177 (74.6)
Tumors $\geq 1$ cm	107/154 (69.5)	107/152 (70.4)
Tumors with a Gleason score $\geq 3 + 4$	96/132 (72.7)	96/141 (68.1)
Index lesions	98/122 (80.3)	98/98 (100.0)
Satellite lesions	34/163 (20.8)	34/79 (43.0)

Note—Data are presented as no. of tumors detected on MRI/total no. of tumors (%).



# Prostate Anatomy

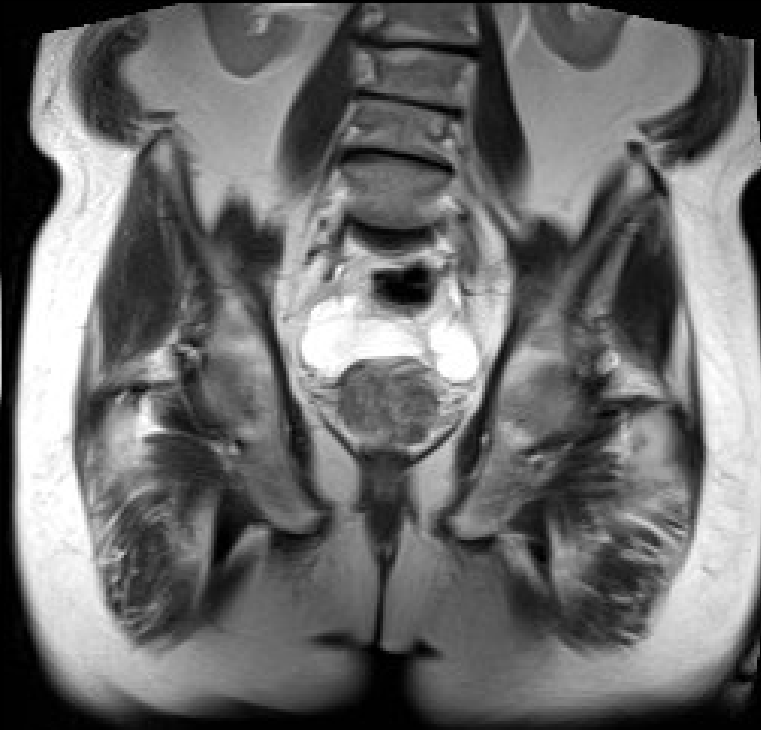


# Our protocol: Multiparametric MR

- HASTE (axial, coronal, sagittal)
- High resolution T2 (axial, coronal, sagittal)
- Precontrast high resolution T1 axial VIBE
- Dynamic post contrast imaging
- Post contrast T1 VIBE (axial, coronal, sagittal)

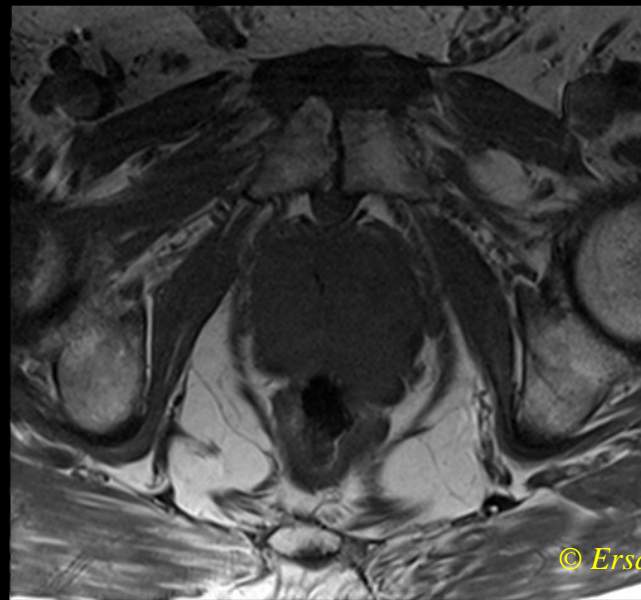
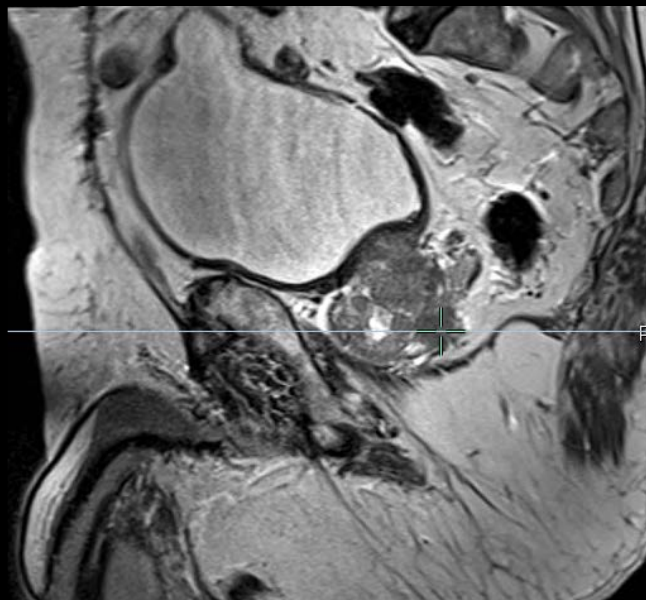
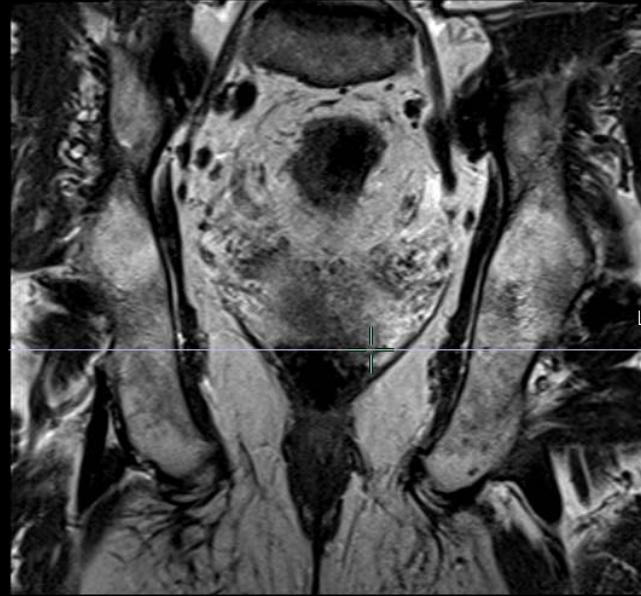
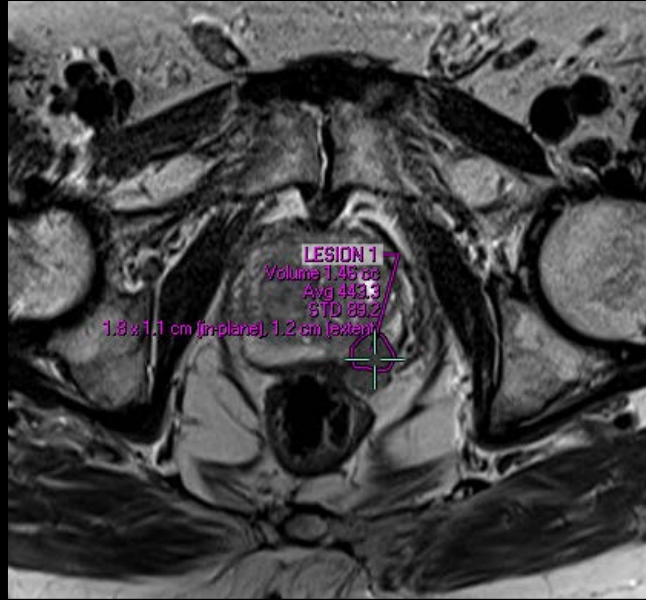
\*\*\*3T magnet is preferred for better signal to noise ratio\*\*\*

# Standard SS-ETSE T2w – HASTE





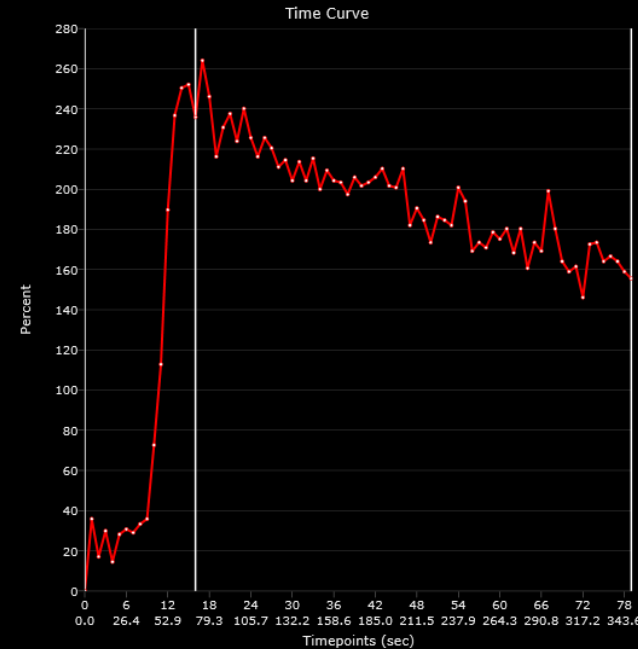
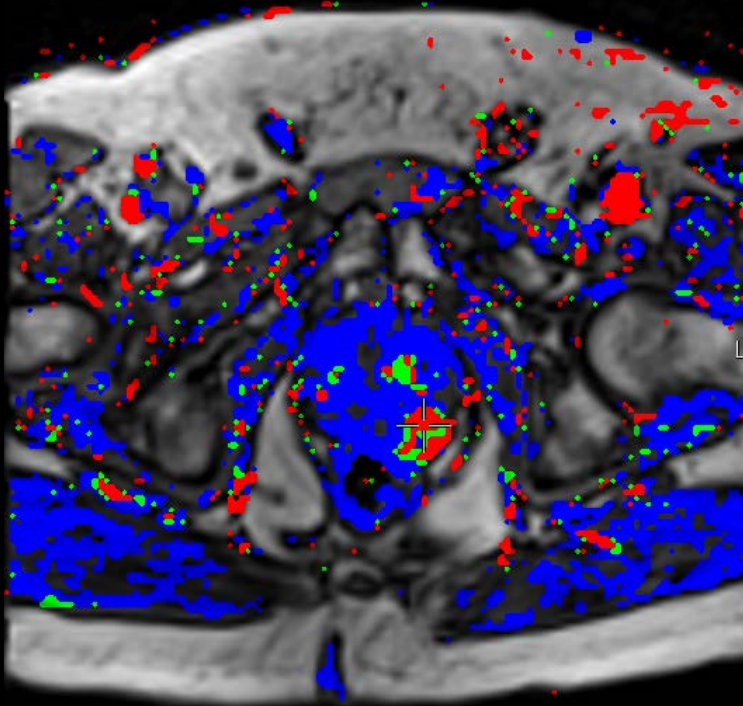
# High Resolution T2w TSE and T1w TSE



# Diffusion Weighted Sequences

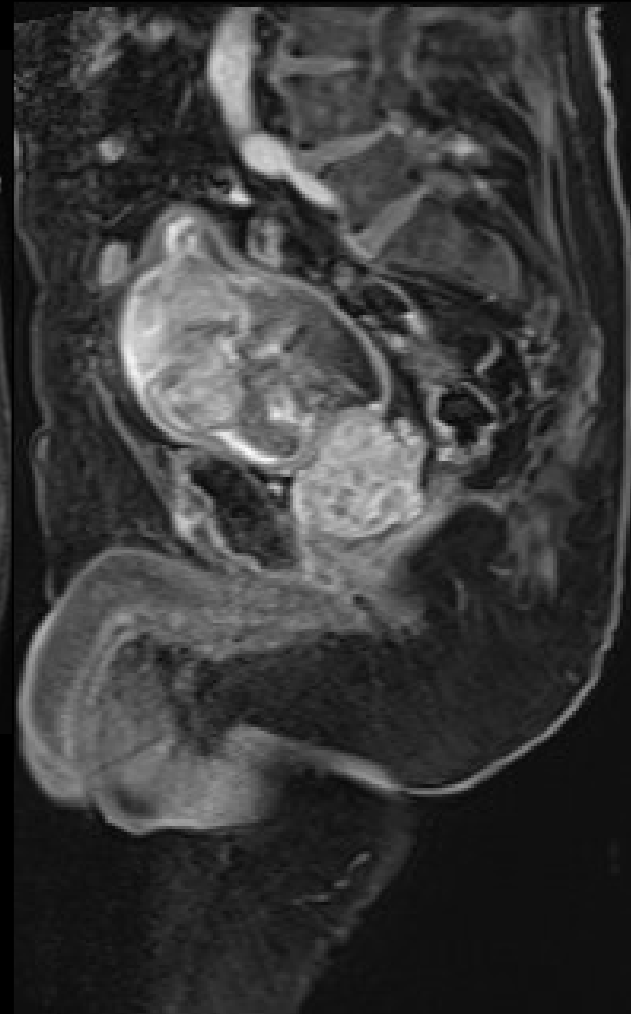
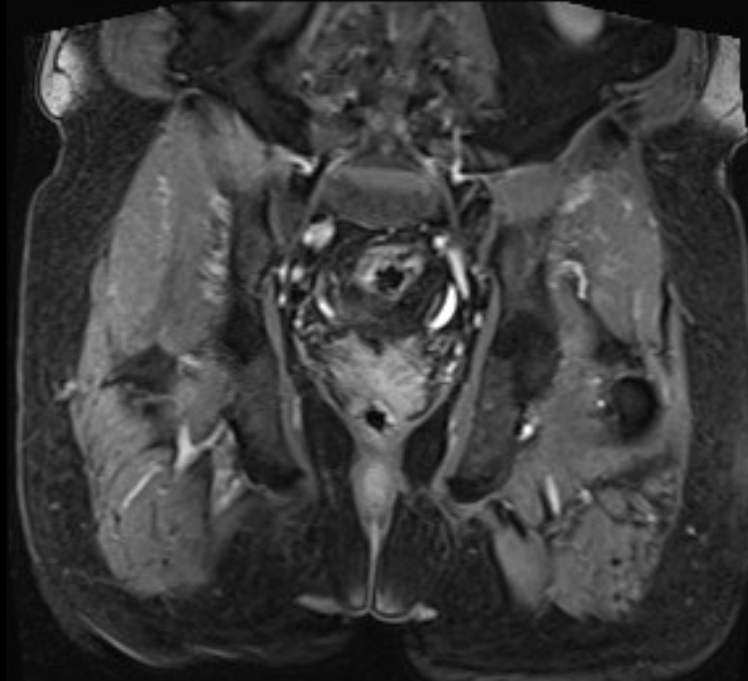
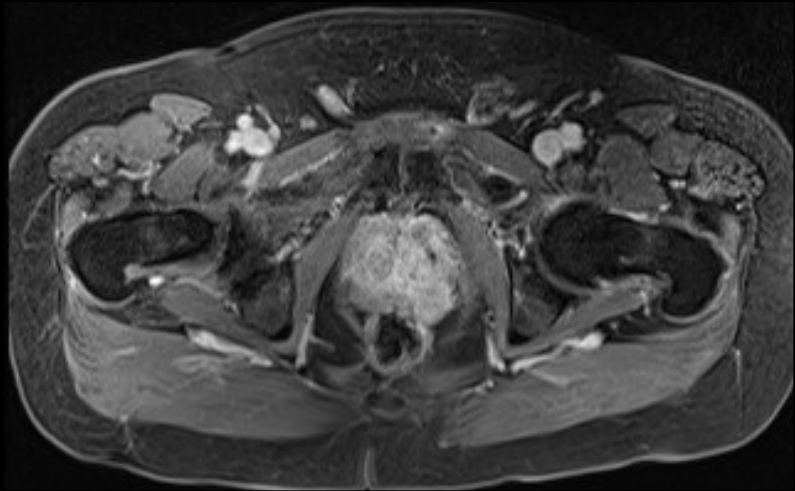


# Dynamic Contrast Enhanced T1w Sequence

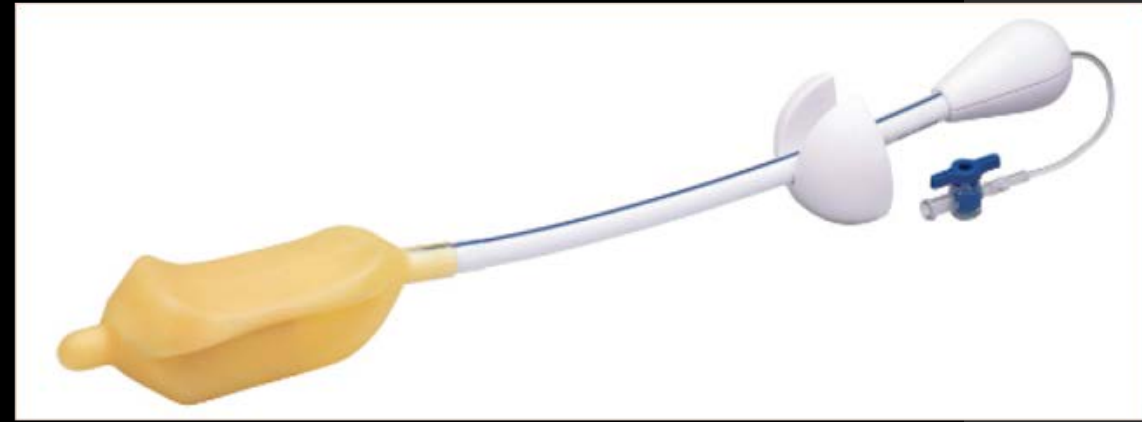


- *Dynamic contrast T1-weighted 3D-GE images (VIBE or TWIST) with high temporal resolution*
- *Temporal resolution is around 4-6 seconds.*
- *Spatial resolution is low and no fat-suppression is used.*
- *Total acquisition time is around 4-5 minutes.*
- *70-80 datasets are acquired from the prostate and SV.*
- *Each dataset lasts 4-6 seconds.*

# Postgadolinium 3D-GE T1w Sequence



# Need for a rectal coil?



## YES – you need it

- Superior sensitivity
  - Particularly at 1.5 T
- Improves radiologists confidence for the detection of prostate cancer

## No – you don't

- Patient discomfort
- Can optimize sequences to improve sensitivity
  - Especially at 3T
- Can distort anatomy
- Increased cost

**At UNC, we don't use one...**

# Pre-procedural preparation:

- Enema??
  - Positive – clear out the rectum
  - Negative – Motion
- Evacuate rectum
- Refrain from ejaculation 3 days prior to MR
  - Greatest distention of the seminal vesicles

# Prior biopsy?

- Wait 6 weeks to decrease changes from inflammation and hemorrhage
- Caveat: presence of hemorrhage is not likely to be substantially compromised secondary to hemorrhage



# The Basics of Reading Prostate MR

- T2
- Diffusion weighted imaging
- Perfusion weighted imaging

# The Basics of Reading Prostate MR

- T2
  - The most important sequence
  - Look for dark T2 signal
- Diffusion weighted imaging
- Perfusion

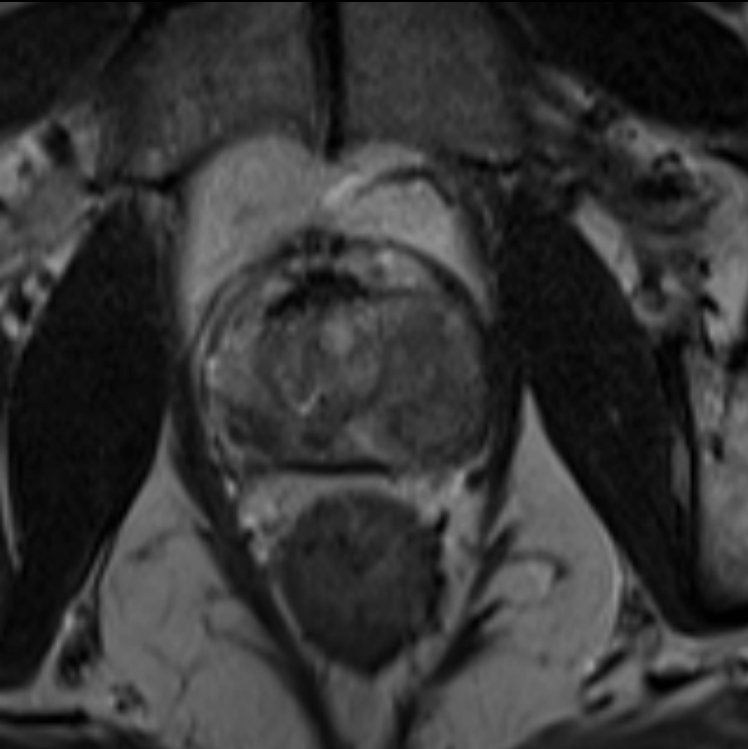
# The Basics of Reading Prostate MR

- **T2** is the most important sequence
  - Look for dark T2 signal
- **Diffusion weighted imaging**
  - Dark on ADC
  - Bright on DWI
  - Higher b-values suppress the relatively T2-hyperintense prostate tissue
    - Compute these high b-values (1500-2000) as direct acquisition is complicated by low signal to noise ratios and severe eddy current distortions
- **Perfusion**

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- **Perfusion**
  - Rapid enhancement and washout on dynamic contrast enhanced imaging
- **ALL 3 = Prostate cancer**

# PIRADS 5 lesion

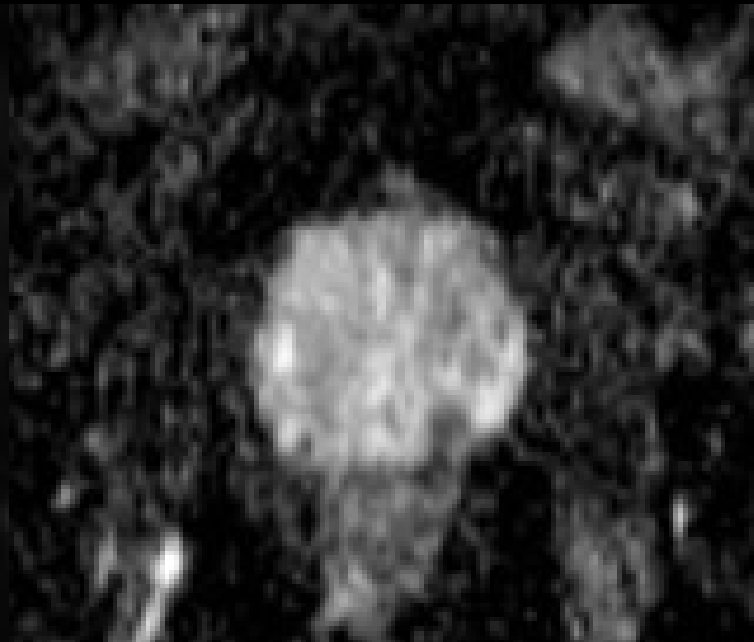
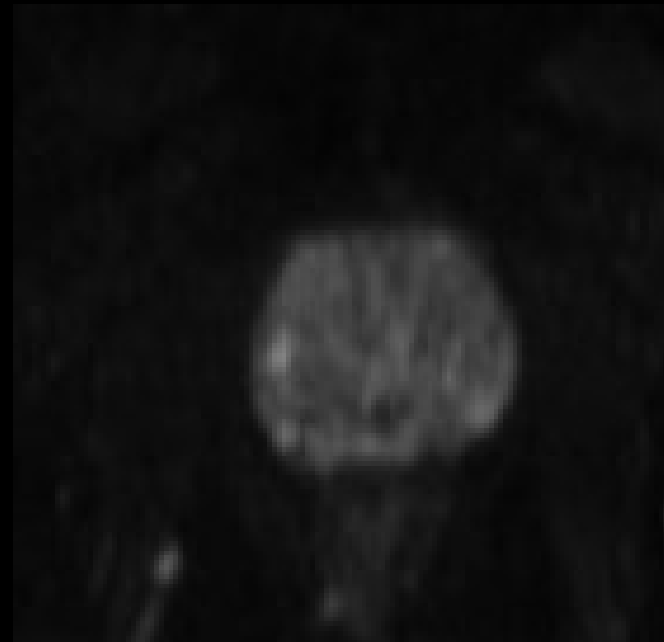
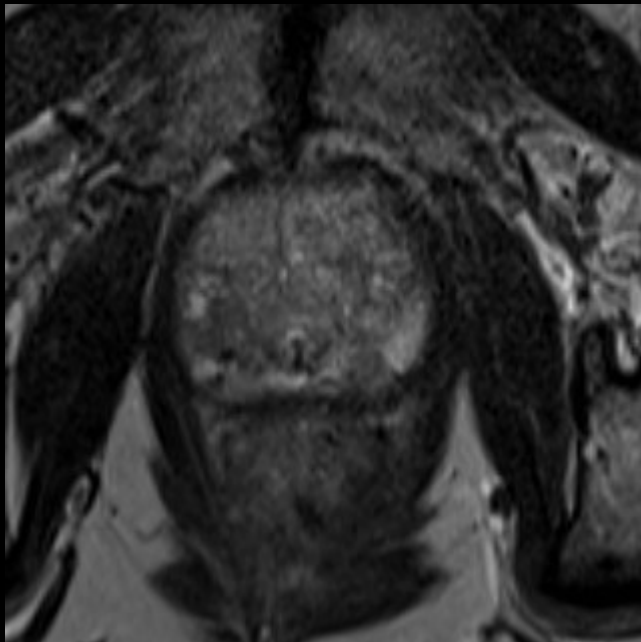


# More specifics...

- ADC value correlates with prostate cancer Gleason score
  - The lower the ADC value = the higher the Gleason score
  - ADC value below 750-900 = more likely to be cancer
- If ADC map is normal in an untreated prostate, prostate cancer is unlikely (even if abnormal T2 signal)
- After radiation therapy, T2 may be limited (entire prostate is low on T2)
  - Rely more on ADC/DWI and perfusion DCE

# Mimics of prostate cancer

- Chronic or granulomatous prostatitis
  - Low T2 signal intensity
  - May have mild diffusion restriction
  - NO MASS EFFECT OR CONTOUR DEFORMITY
  - DEGREE OF LOW T2 SIGNAL IS LESS THAN PROSTATE CANCER
    - It's all about the level of gray



# Which prostate cancers do we miss?

- Low Gleason score (6 or less)
- Organ-confined
- Small or very small in size (less than 10% volume)
- Satellite lesions



# PIRADS 2

- Promotes standardization of reporting and communication between radiologists and urologists
- Provides assessment categories that summarize levels of suspicion or risk of significant prostate cancer
- Combines the findings on T2, DWI, DCE

PIRADS 1 – Very low (clinically significant cancer is highly unlikely to be present)

PIRADS 2 – Low (clinically significant cancer is unlikely to be present)

PIRADS 3 – Intermediate (the presence of clinically significant cancer is equivocal)

PIRADS 4 – High (clinically significant cancer is likely to be present)

PIRADS 5 – Very high (clinically significant cancer is highly likely to be present)

# PIRADS 2

Score	Transition Zone (TZ)
1	Homogeneous intermediate signal intensity (normal)
2	Circumscribed hypointense or heterogeneous encapsulated nodule(s) (BPH)
3	Heterogeneous signal intensity with obscured margins  Includes others that do not qualify as 2, 4, or 5
4	Lenticular or non-circumscribed, homogeneous, moderately hypointense, and <1.5 cm in greatest dimension
5	Same as 4, but $\geq 1.5$ cm in greatest dimension or definite extraprostatic extension/invasive behavior

Score	Peripheral Zone (PZ)
1	Uniform hyperintense signal intensity (normal)
2	Linear or wedge-shaped hypointensity or diffuse mild hypointensity, usually indistinct margin
3	Heterogeneous signal intensity or non-circumscribed, rounded, moderate hypointensity  Includes others that do not qualify as 2, 4, or 5
4	Circumscribed, homogenous moderate hypointense focus/mass confined to prostate and <1.5 cm in greatest dimension
5	Same as 4 but $\geq 1.5$ cm in greatest dimension or definite extraprostatic extension/invasive behavior

Score	Peripheral Zone (PZ) or Transition Zone (TZ)
1	No abnormality (i.e., normal) on ADC and high b-value DWI
2	Indistinct hypointense on ADC
3	Focal mildly/moderately hypointense on ADC and isointense/mildly hyperintense on high b-value DWI.
4	Focal markedly hypointense on ADC and markedly hyperintense on high b-value DWI; <1.5cm in greatest dimension
5	Same as 4 but $\geq 1.5$ cm in greatest dimension or definite extraprostatic extension/invasive behavior

## PI-RADS Assessment for DCE

Score	Peripheral Zone (PZ) or Transition Zone (TZ)
(-)	no early enhancement, or diffuse enhancement not corresponding to a focal finding on T2W and/or DWI or focal enhancement corresponding to a lesion demonstrating features of BPH on T2WI
(+)	focal, and; earlier than or contemporaneously with enhancement of adjacent

# Can anyone read prostate MR?

- Right now, any board certified radiologist can read prostate MR
- Recent push towards certification

# Conclusions

- Prostate MR has come a long way
- Good sensitivity and specificity for prostate cancer
- Not full proof
  - Still miss low grade prostate cancer
    - But these may not be as clinically relevant
  - Certain conditions can mimic prostate cancer
- Recent software allows for MRI fusion biopsy

So, is prostate MRI  
ready for primetime?

Yes!

