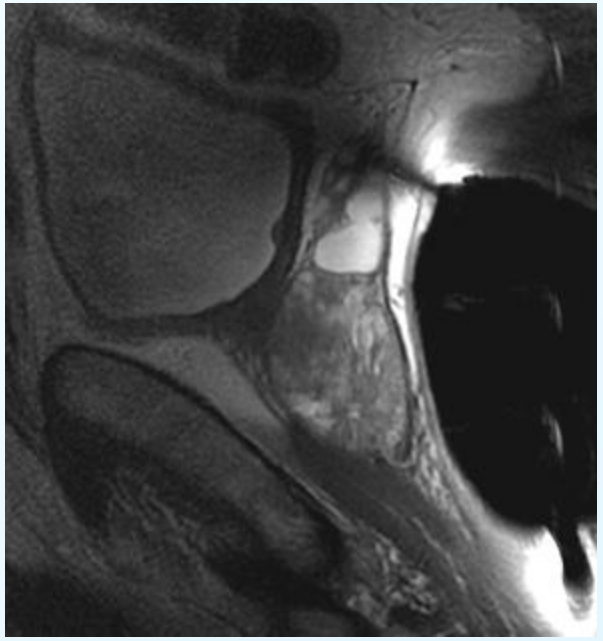
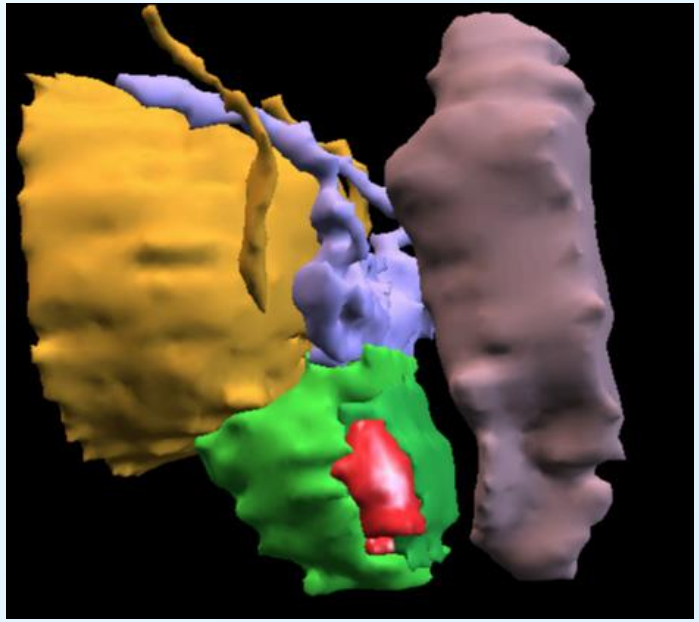
Prostate Cancer Recurrence Reporting & the role of MRI in post focal therapy assessment

ARGANZ session 4B March 8th





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Disclosures

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- RO1 EB 030539
- UO1 CA 268810

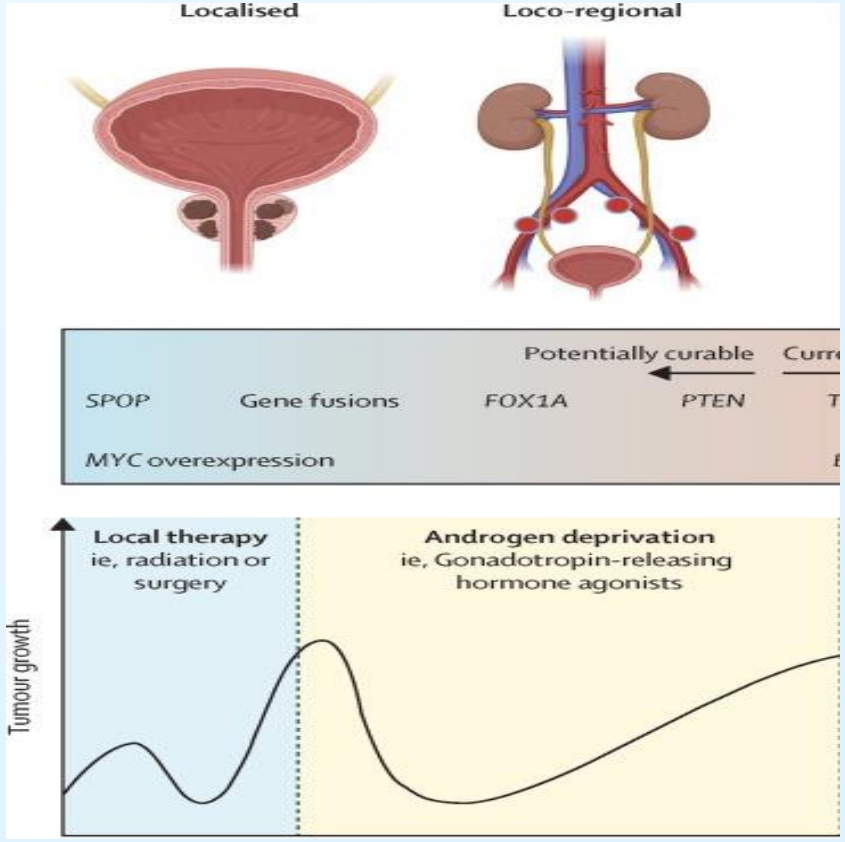
- Advisor & Speaker Bureau: Medscape
- Contributor: UpToDate
- Prior co-Chair ACR PI-RADS
- Prior clinical trial site PI for InSightec Inc (MRgFUS)

Learning objectives

1. **To understand current Prostate cancer treatments used for loco-regional disease.**
2. To review the appearance of the prostate gland after therapy
3. To learn how to identify and report post treatment local recurrence

Prostate Cancer Treatments: Localized Disease

- Whole Gland and Focal
- Commonest therapies for localized PCa are **whole gland**
  - Radical Prostatectomy or Whole gland Radiation
- **Focal** ablative: Sub-total MR image guided treatment
  - Only possible if MR visible lesion
- MR guided focal therapy types
  - Radiation EBRT, SBRT, brachytherapy
  - Ablation
    - Cryoablation/ Photodynamic therapy
    - Laser/ Microwave
    - HIFU/MRgFUS

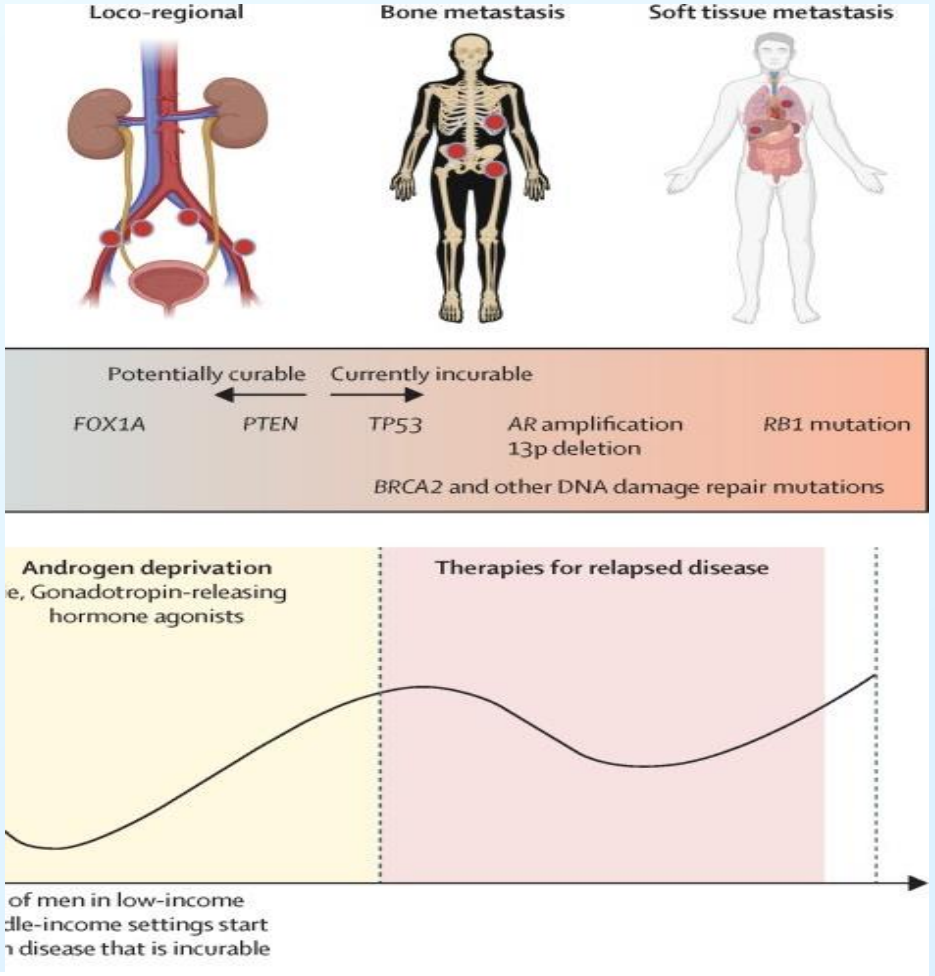


Prostate Cancer Treatments: Loco-regional & Metastatic

- ADT Androgen deprivation Testosterone reducing agent
- Androgen receptor (AR) axis inhibitor
  Abiraterone or chemotherapy with Docetaxel

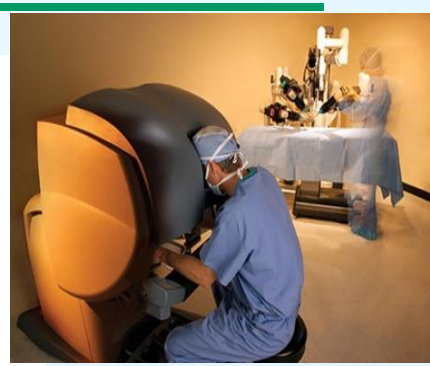
- Metastatic castration-resistant mCRPC
  - Cytotoxic chemotherapies, AR-directed, therapeutic vaccines, and Theranostic agents

- Theranostics: Alpha or beta emitters (^{177}Lu-PSMA)



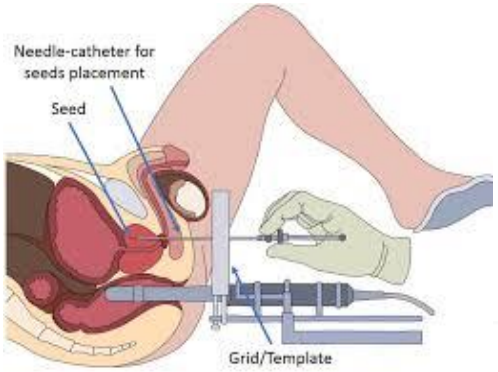
O'Dwyer E, Bodei L, Morris MJ. The Role of Theranostics in Prostate Cancer. Semin Radiat Oncol. 2021 Jan;31(1):71-82. doi: 10.1016/j.semradonc.2020.07.004. PMID: 33246638; PMCID: PMC8391014.

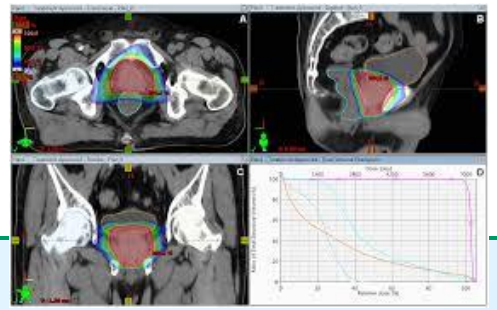
Prostate Cancer Treatments



Localized PCa- *Key issues high risk for recurrence*

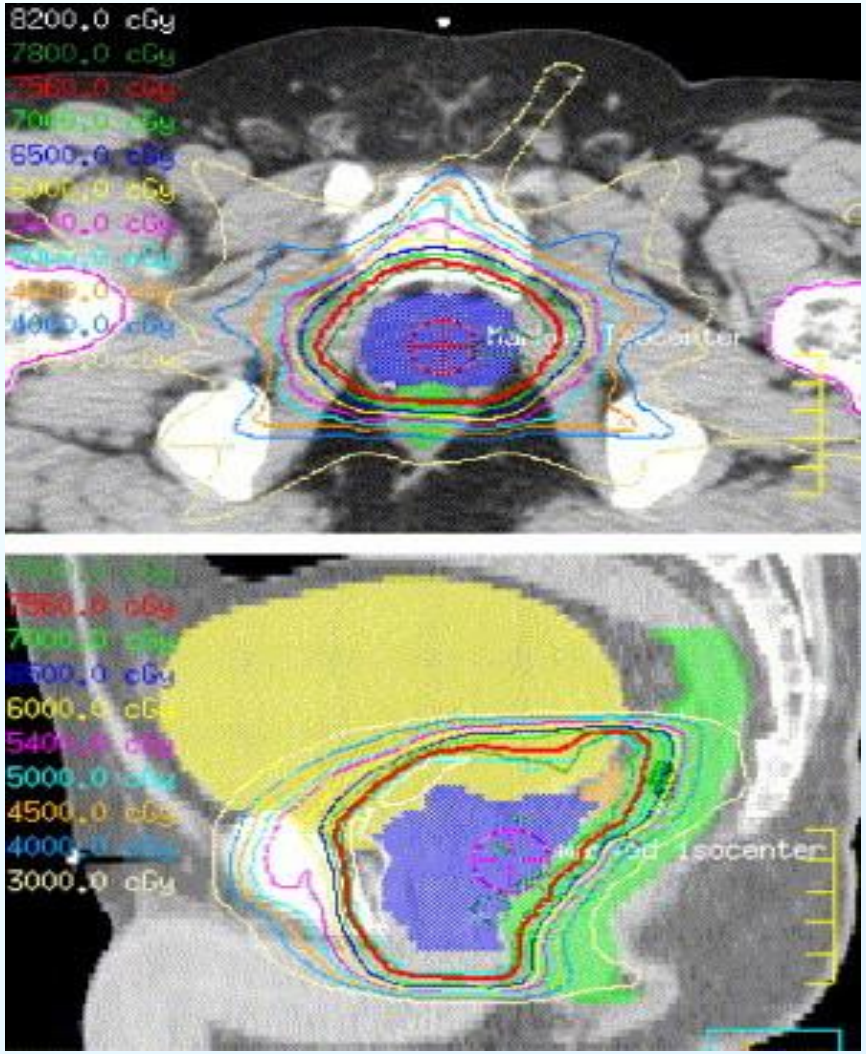
- **Radical prostatectomy**
- Always review pre-op imaging and the path report to assess Index lesion site, number of cancers size/volume (tumor burden) final TNM stage and margin status
- Tumor size/volume, location & stage
  - PSA>0
- **Radiation-EBRT, Brachytherapy**
  - Tumor dose volume-DVH
  - PSA Nadir/Phoenix



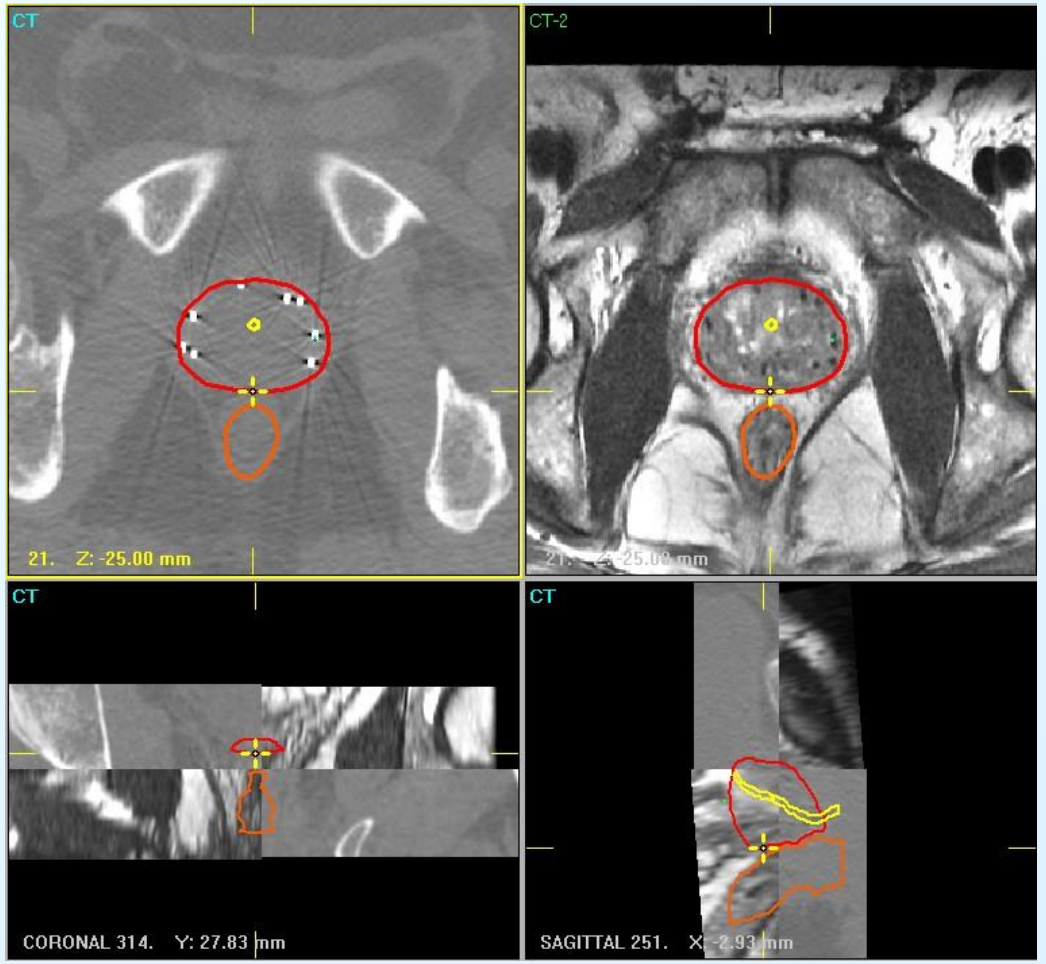


EBRT and Brachytherapy

EBRT



Brachytherapy

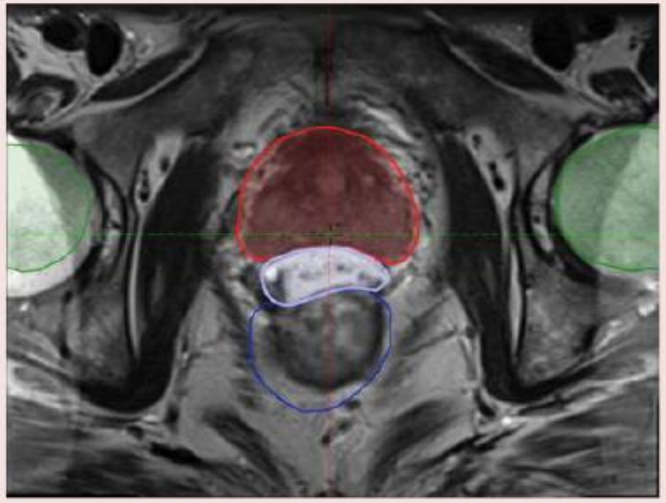


Update on Radiation Therapy in Prostate Cancer
Hematology/Oncology Clinics of North America - Volume 20, Issue 4 (August 2006)
Update on Radiation Therapy in Prostate Cancer Andrew K. Lee, MD, MPH, Steven J. Frank, MD

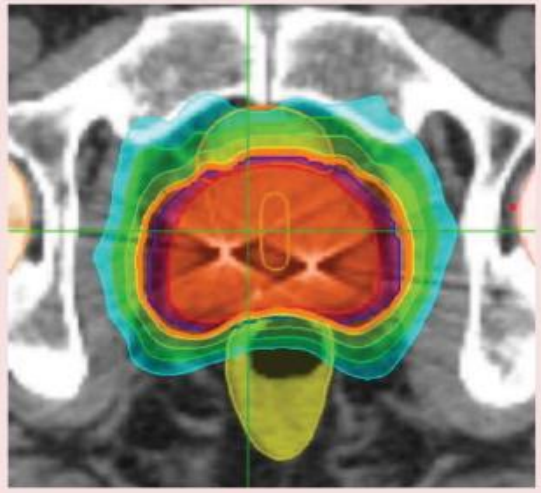
Prostate MRI in Stereotactic Body Radiation Treatment Planning and Delivery for Localized Prostate Cancer

Radiation treatment planning

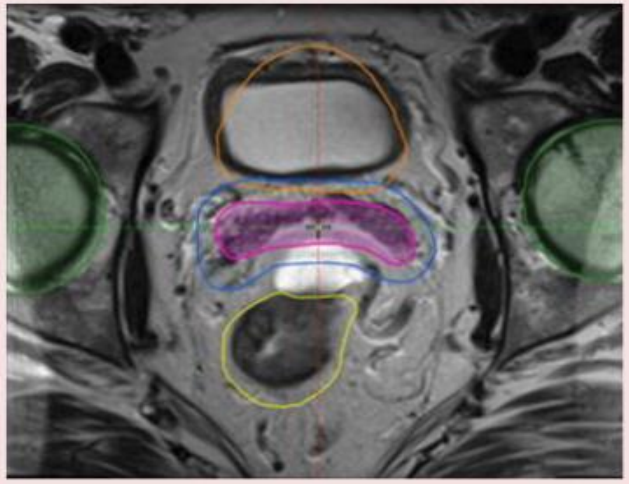
Fiducial marker placement



Tumor volume measurement



Contouring for target delineation

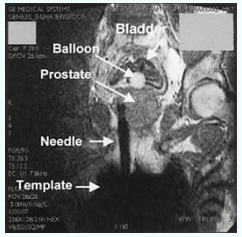


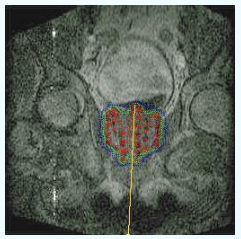
Nigogosyan Z et al. Published online: June 17, 2022
https://doi.org/10.1148/rg.210114

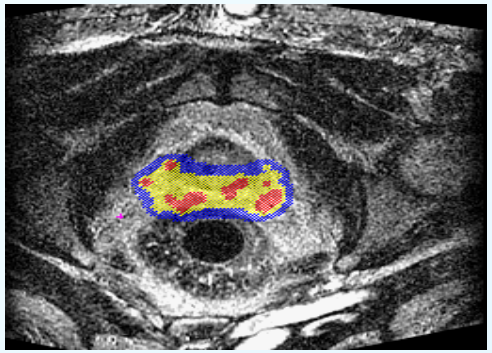
RadioGraphics

Nigogosyan Z. Published Online: June 17, 2022
https://doi.org/10.1148/rg.210114

MR Guided Radiation Delivery Systems: IGRT (Solutions)







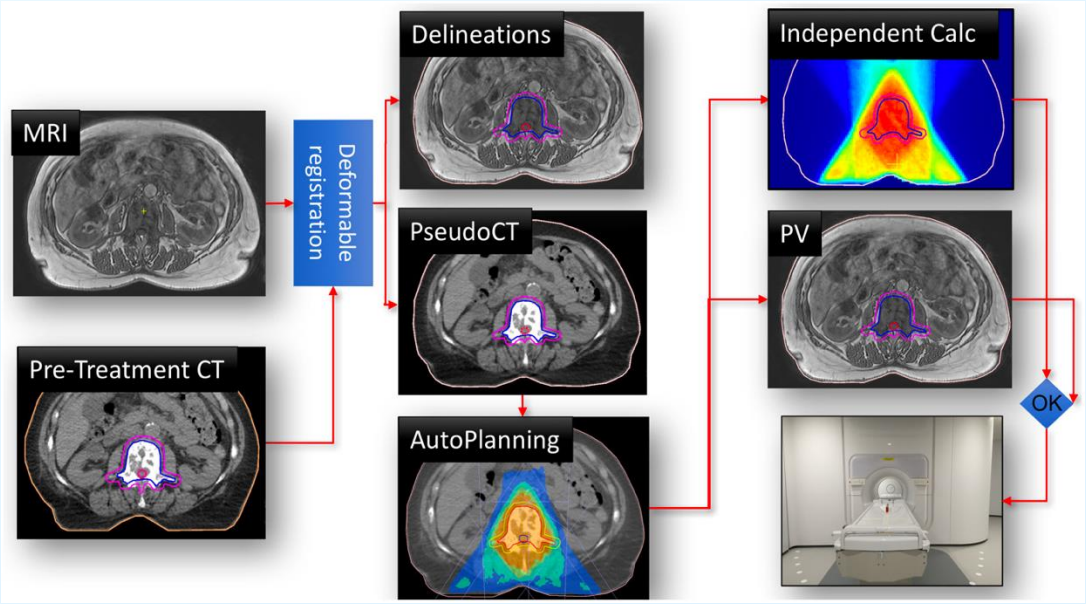
D'Amico AV, Cormack RA, Tempany CM, Kumar S, Topulos G, Kooy HM, Coleman CN.

Real-time magnetic resonance image-guided interstitial brachytherapy in the treatment of select patients with clinically localized prostate cancer.

Int J Radiat Oncol Biol Phys. 1998 Oct; 42(3):507-15. PMID: 9806508.

D'Amico AV, Cormack RA, Tempany CM**. MRI-guided diagnosis and treatment of prostate cancer.** N Engl J Med. 2001 0103083441017. PMID: 11236795.

Raaymakers BW, Jürgenliemk-Schulz IM, Bol GH, Glitzner M, …et al Lagendijk JJW. **First patients treated with a 1.5 T MRI-Linac: clinical proof of concept of a high-precision, high-field MRI guided radiotherapy treatment.** Phys Med Biol. 2017 Nov 14;62(23):L41-L50. PMID: 29135471.



https://static.elekta.com/unity-assets/unity-plan.mp4

Learning objectives

1. To understand current Prostate cancer treatments used for loco-regional disease.
2. **To review the appearance of the prostate gland after therapy**
3. To learn how to identify and report post treatment local recurrence

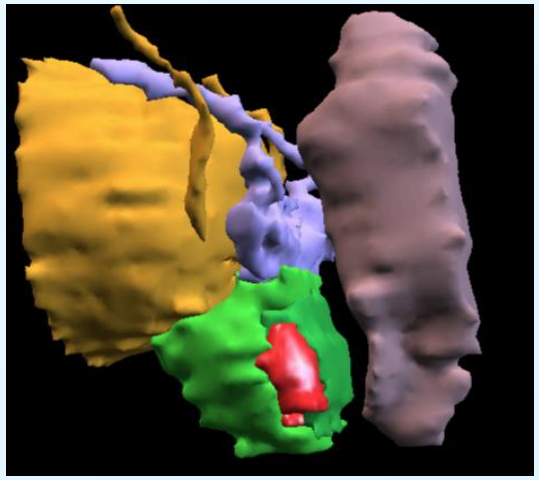
Biochemical recurrence/BCR

- *Biochemical recurrence*: detectable prostate-specific antigen (PSA) with a subsequent rise after radical prostatectomy
  - PSA value < 0.2 ng/mL =undetectable

- *Phoenix criteria*
  - $\geq$ 2.0 ng/mL rise above the nadir after radiotherapy

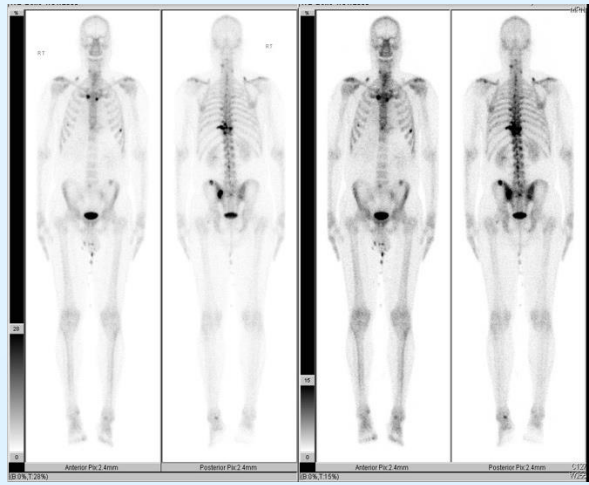
Prostate Cancer recurrence

- **Major Clinical issue: Identification of the site of recurrence**
  - Local
  - Distant



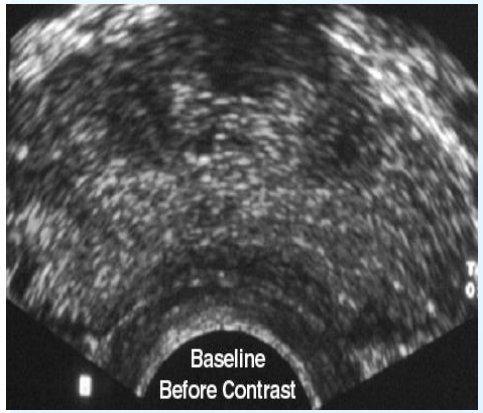
- Biochemical recurrence BCR= Rising PSA after treatment
  - Rates of BCR within 10 yrs of Rx
    - 20–40% of patients undergoing RP
    - 30–50% of patients undergoing RT

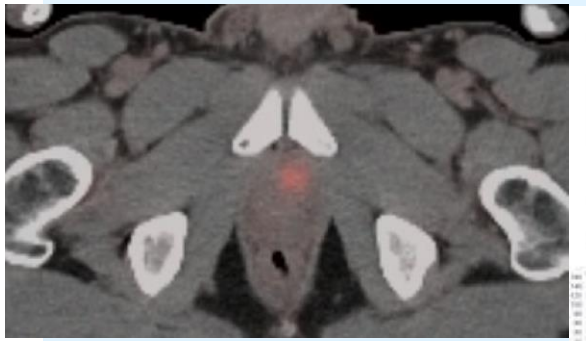
- BCR following RRP, only 34% of men develop metastatic disease
  - Unfavorable indicators
    - Time to recurrence (1-2 years)
    - PSA doubling time (PSADT) < 6-10 months

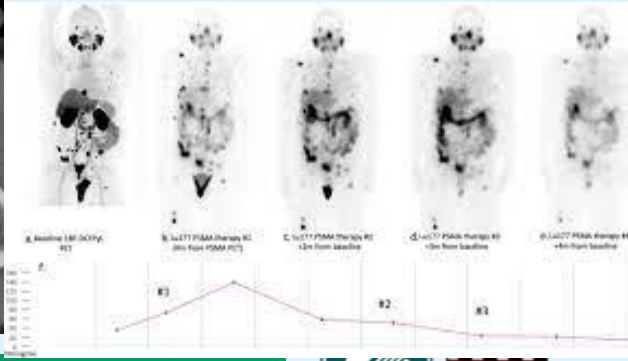


Imaging modalities for recurrent Prostate cancer

- **mpMRI with whole body MR**
- Ultrasound: Local rec. post RPR
- CT: Primarily for lymphadenopathy
- Nuclear medicine-Bone mets
  - Tc 99m Bone scan (PSA < 10mg/mL 1% positive)
  - PET-- FDG/PSMA

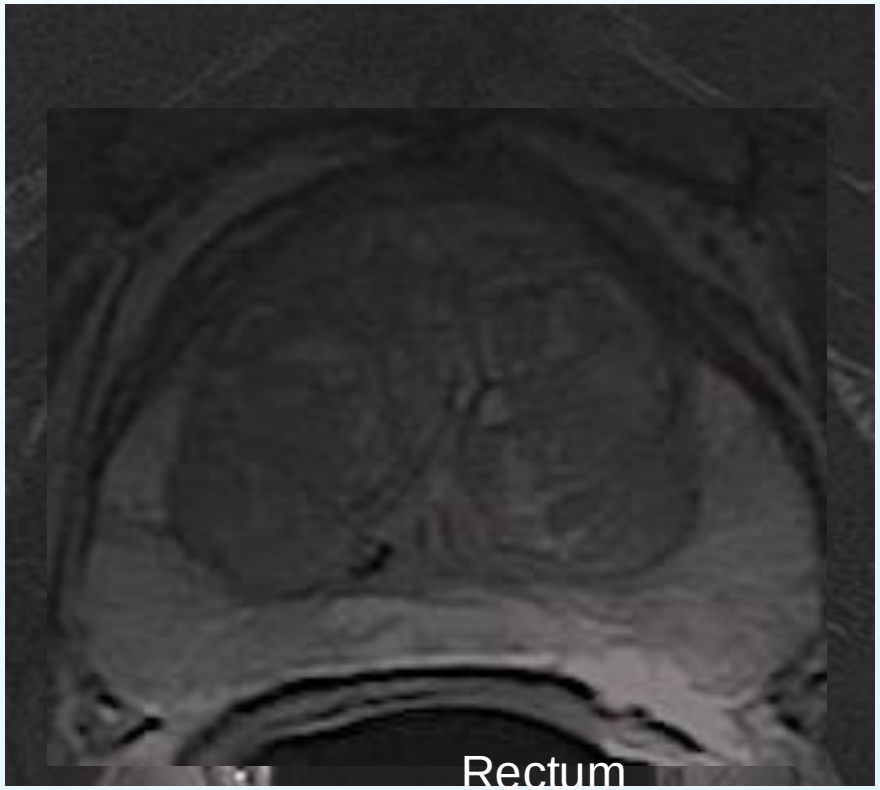


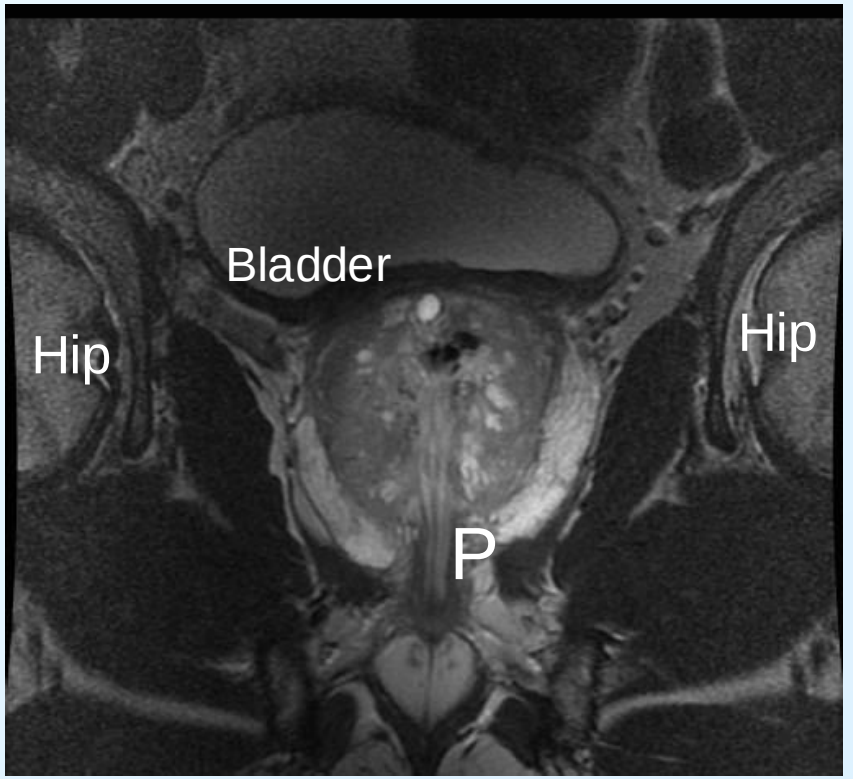




State of the art: Multiparametric MR

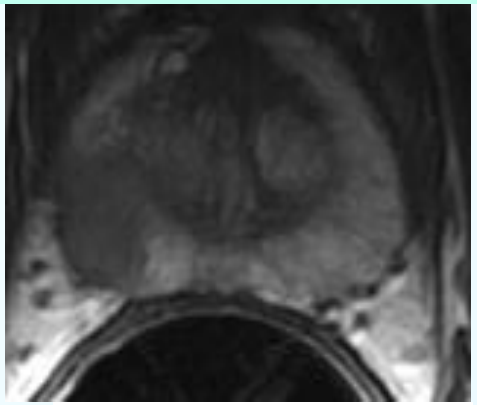
1. Diffusion/Apparent Diffusion Coefficient (ADC)
2. T2-Weighted
3. IV contrast /Dynamic contrast enhanced (DCE)



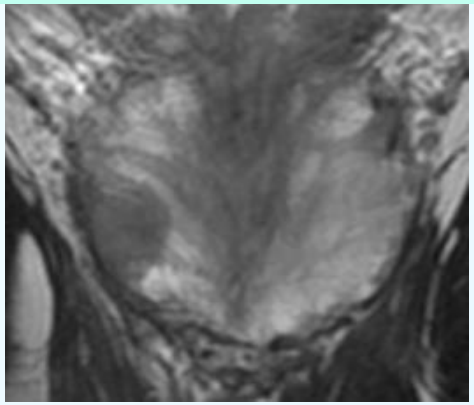


Hegde J et al JMRI 2013 37:1035-1054

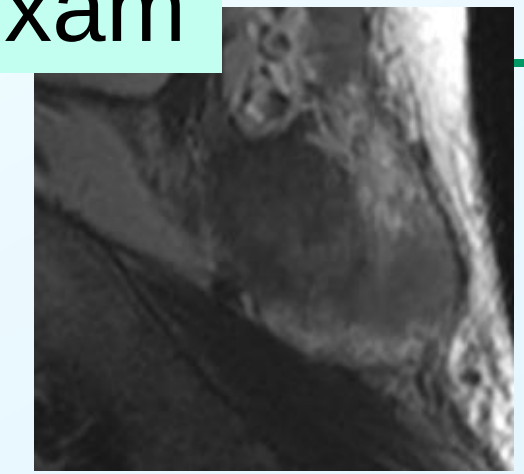
Focal prostate cancer on mpMRI exam



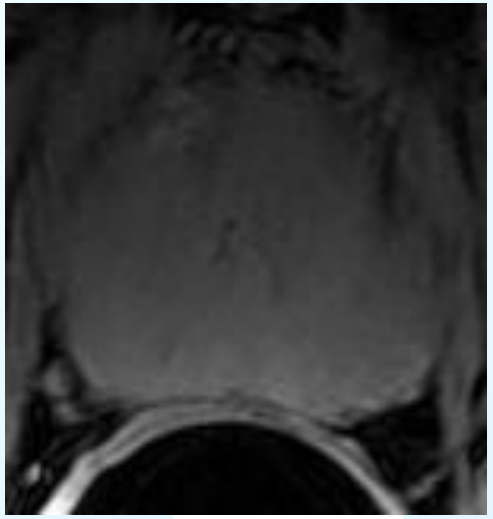
Axial T2WI



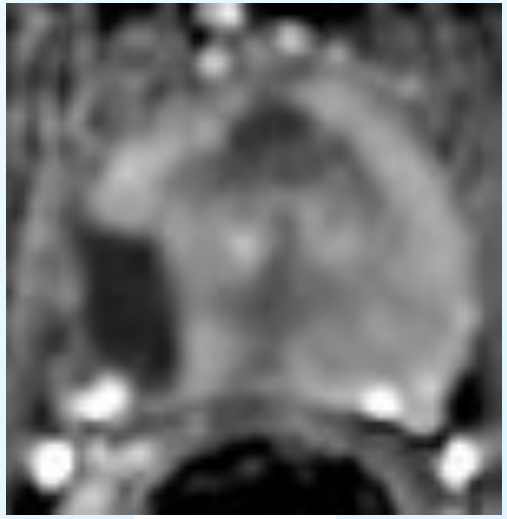
Cor T2WI



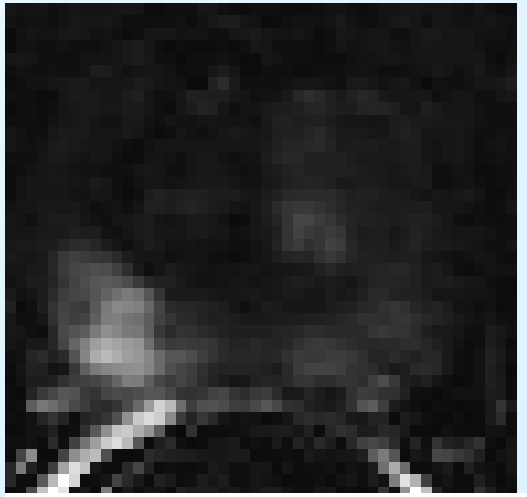
Sag T2WI



T1WI

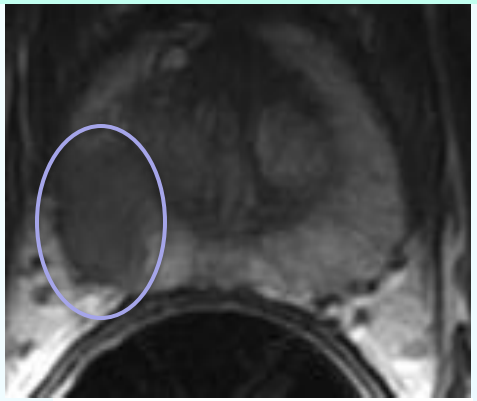


ADC

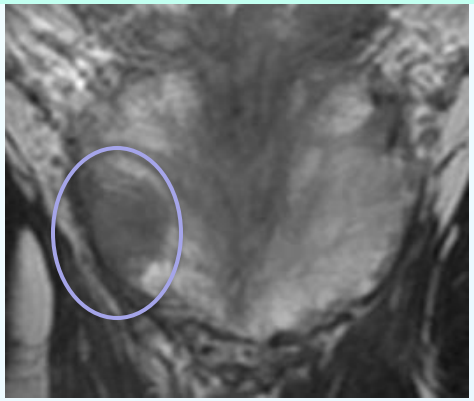


DCE subtraction

Focal prostate cancer on mpMRI exam

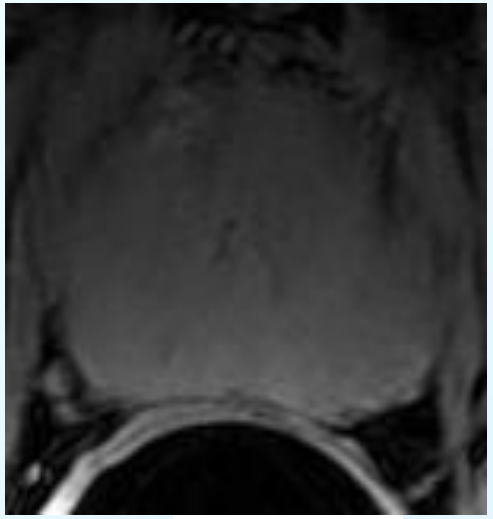


Axial T2WI

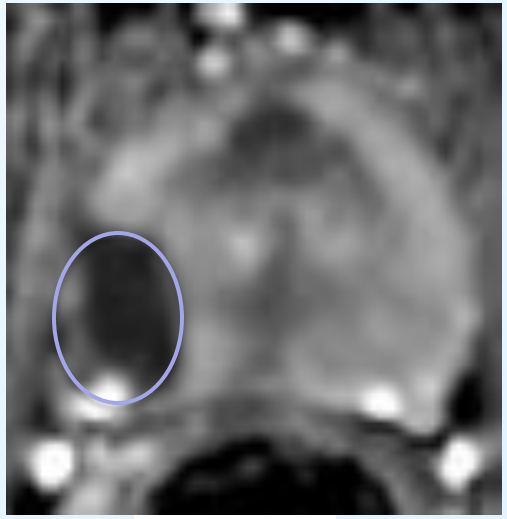


Cor T2WI

Sag T2WI



T1WI



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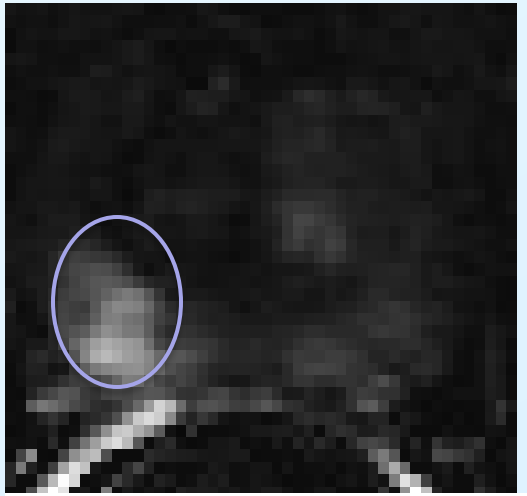
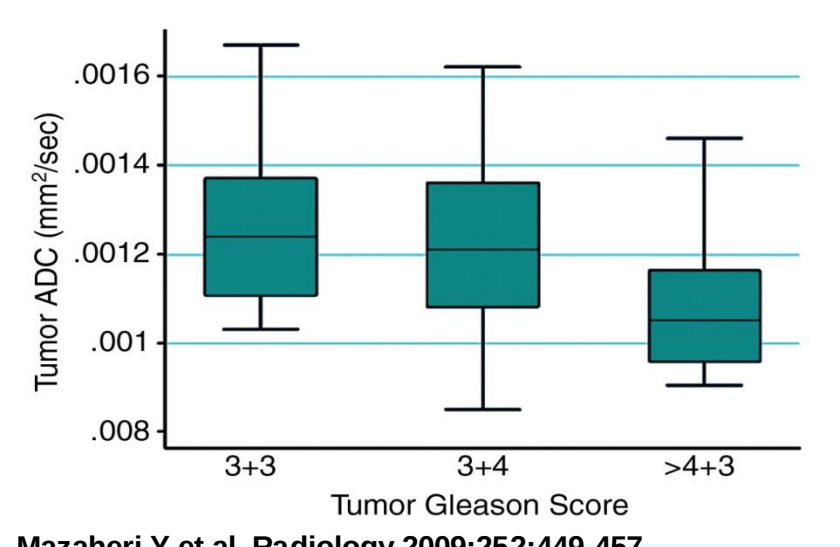
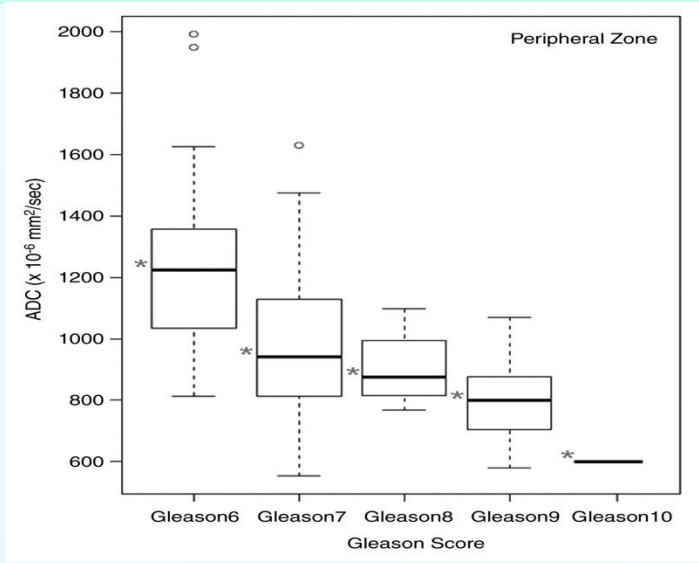


DCE subtraction

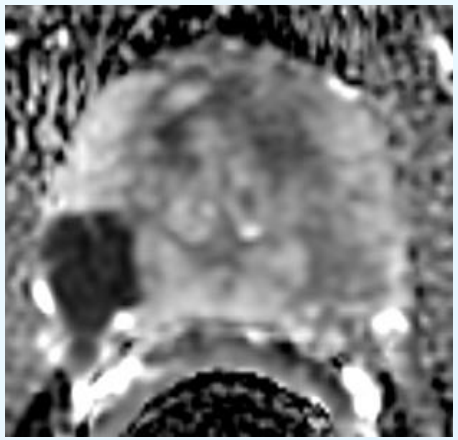
ADC In vivo Biomarker: correlates with Gleason Grade

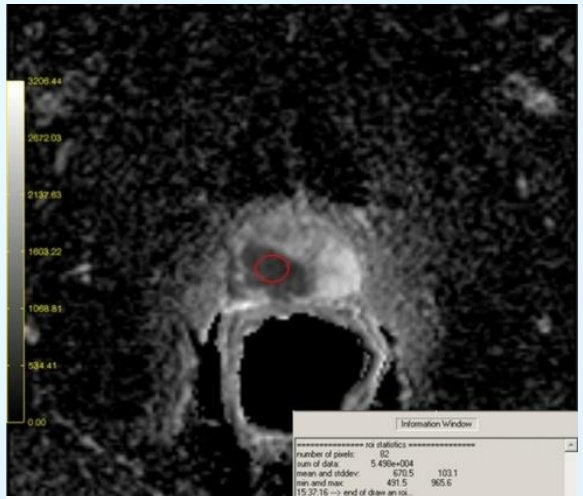


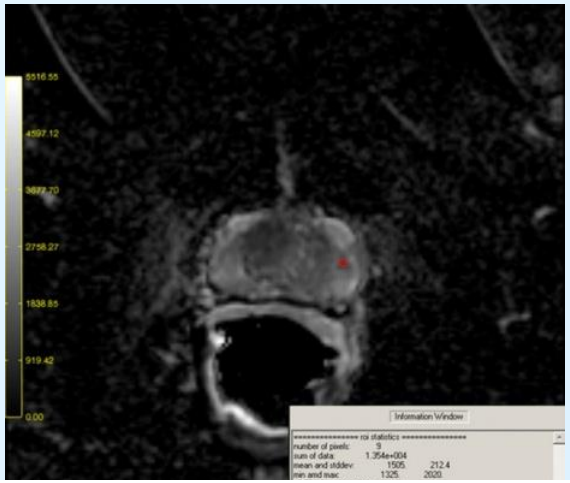
Mazaheri Y et al. Radiology 2009;252:449-457



Turkbey B et al. Radiology 2011;258:488-495







ADC-670 ----G 4 +4 ADC1500---G 3+3

PI-RADS Assessment Categories

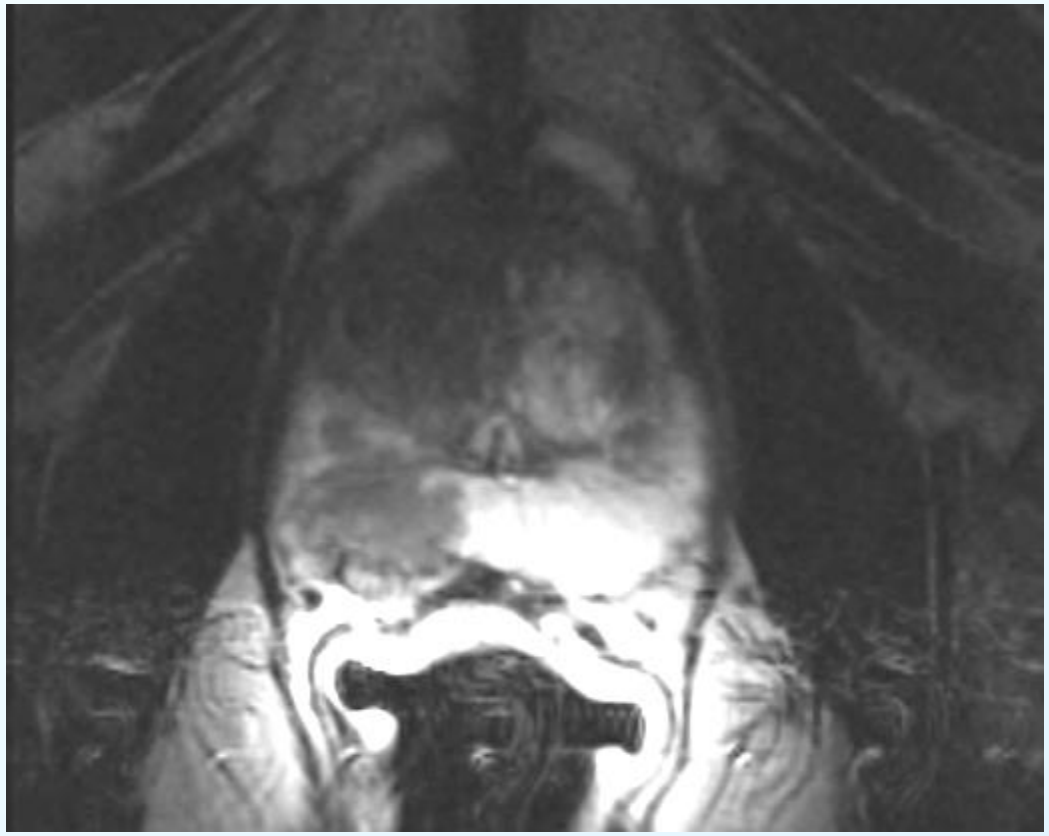
Specifically for treatment Naïve patients

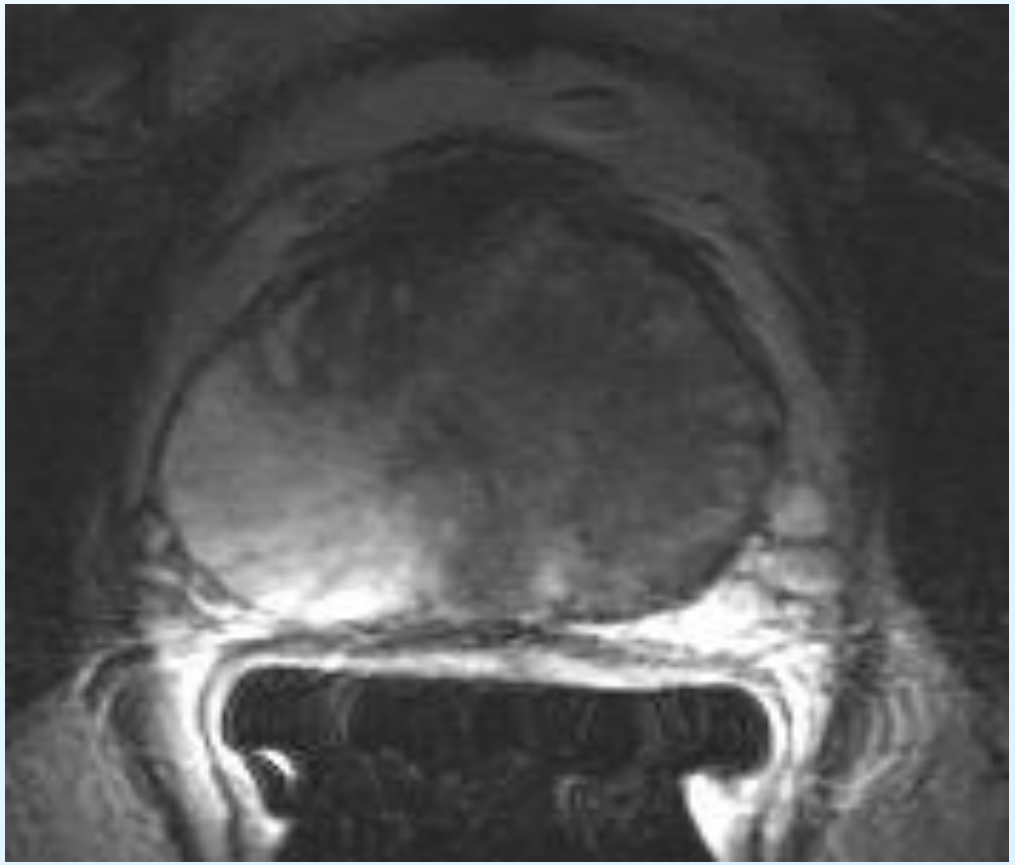
1	very low	clinically significant cancer* **highly unlikely**
2	low	clinically significant cancer is **unlikely**
3	intermediate	clinically significant cancer is **equivocal**
4	high	clinically significant cancer **is likely**
5	very high	clinically significant cancer is **highly likely**

*** Gleason pattern 4 and/or volume >0.5ccs**

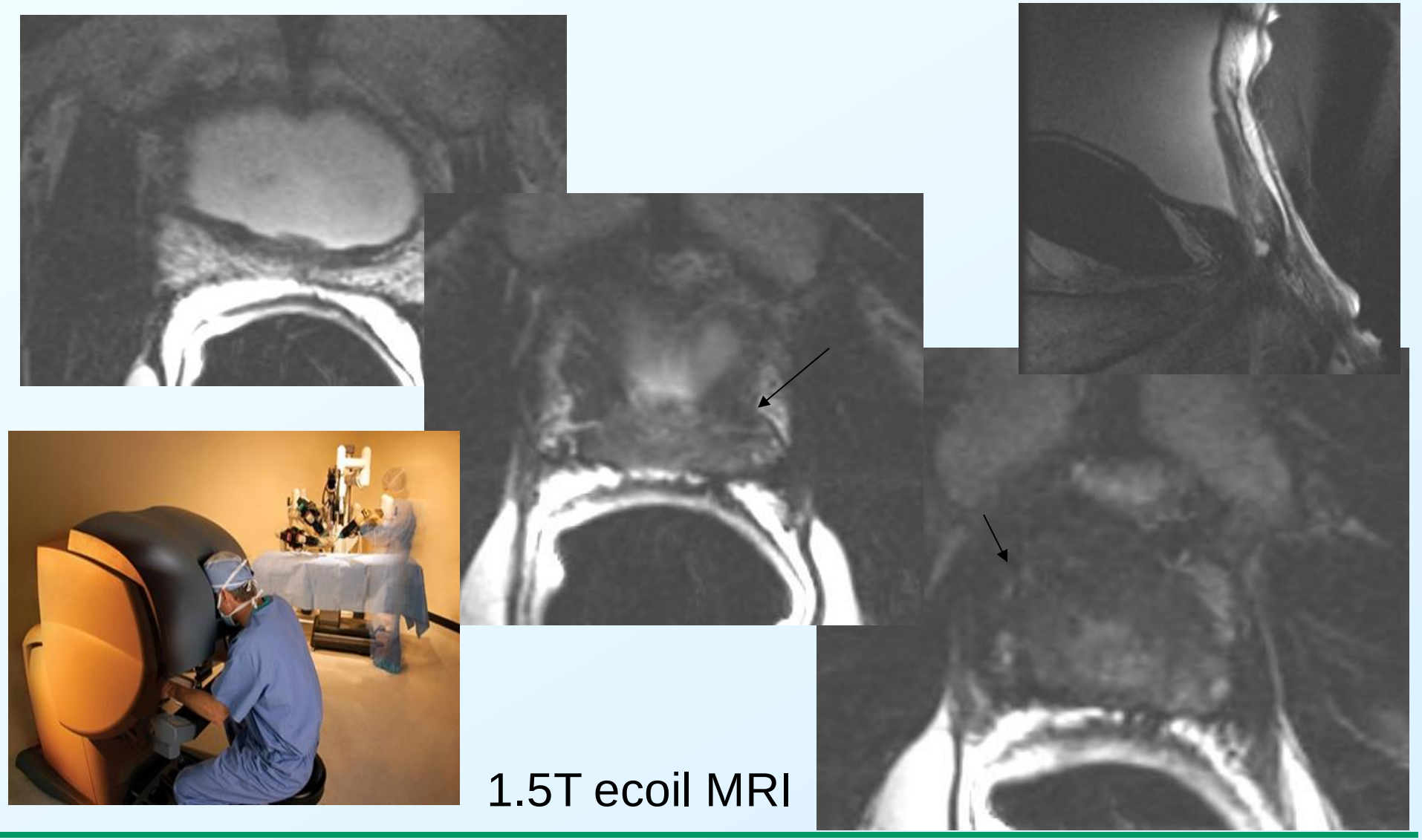
Weinreb JC, Barentsz JO, Choyke PL, Cornud F, Haider MA, Macura KJ, Margolis D, Schnall MD, Shtern F, Tempany CM, Thoeny HC, Verma S. PI-RADS Prostate Imaging - Reporting and Data System: Version 2.
Eur Urol 2016 Jan;69(1):16-40. PMID: 26427566

2 forms of tumor: Focal and diffuse





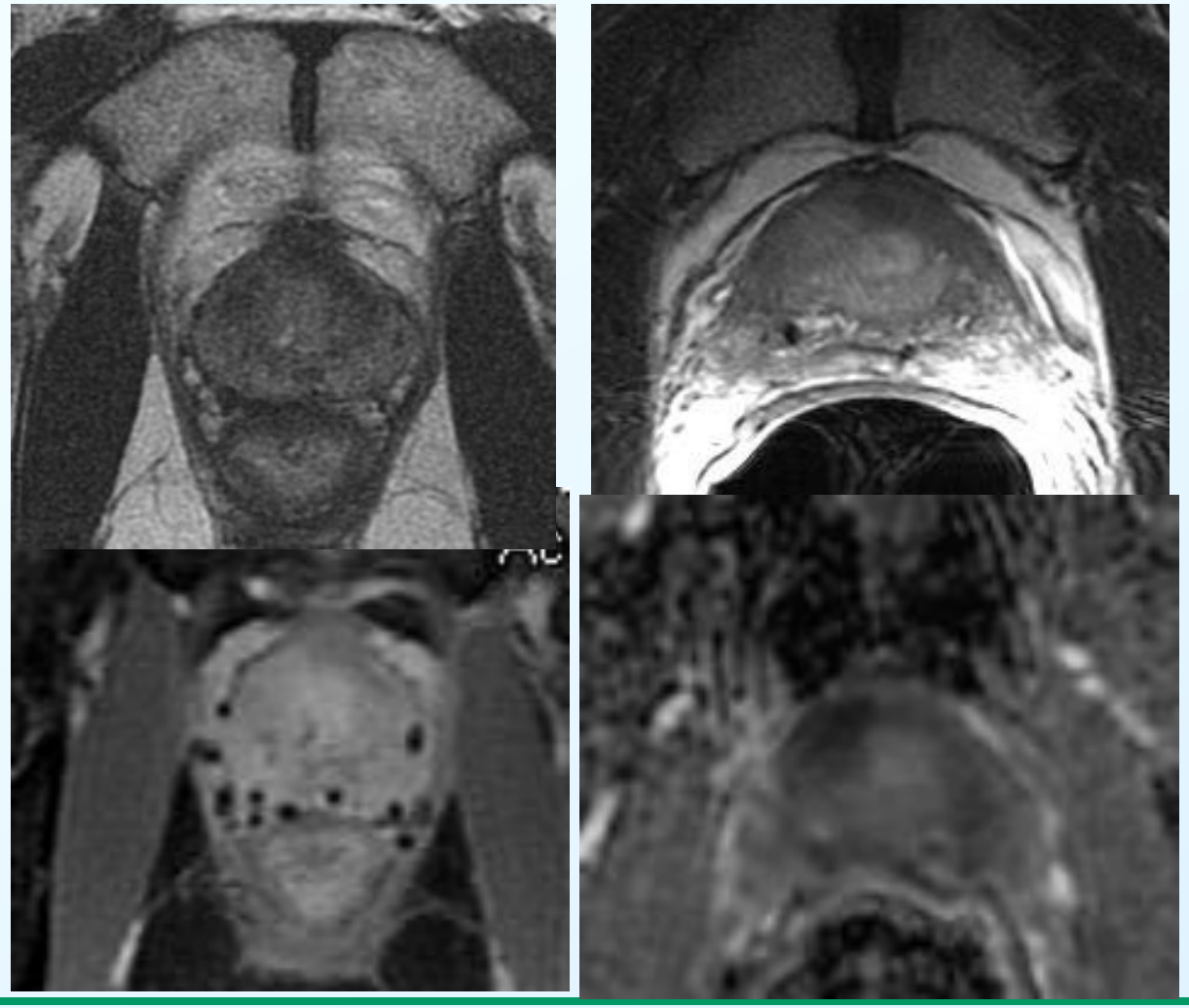
MRI 6 months post Robotic Radical prostatectomy: Rising PSA



1.5T ecoil MRI

Post Brachytherapy rising PSA

6 weeks 6 months



Right anterior lesion

9-12 o'clock

Low T2W

Low ADC

ASCO special articles

Optimum Imaging Strategies for Advanced Prostate Cancer: ASCO Guideline

Edouard J. Trabulsi, MD[1]; R. Bryan Rumble, MSc[2]; Hossein Jadvar, MD, PhD[3]; Thomas Hope, MD[4]; Martin Pomper, MD, PhD[5]; Baris Turkbey, MD[6]; Andrew B. Rosenkrantz, MD[7]; Sadhna Verma, MD[8]; Daniel J. Margolis, MD[9]; Adam Froemming, MD[10]; Aytekin Oto, MD[11]; Andrei Purysko, MD[12]; Matthew I. Milowsky, MD[13]; Heinz-Peter Schlemmer, MD[14]; Matthias Eiber, MD[15]; Michael J. Morris, MD[16]; Peter L. Choyke, MD[6]; Anwar Padhani, MD[17]; Jorge Oldan, MD[13]; Stefano Fanti, MD[18]; Suneil Jain, NMD[19]; Peter A. Pinto, MD[6]; Kirk A. Keegan, MD[20]; Christopher R. Porter, MD[21]; Jonathan A. Coleman, MD[16]; Glenn S. Bauman, MD[22]; Ashesh B. Jani, MD[23]; Jeffrey M. Kamradt, MD[24]; Westley Sholes, MPA; and H. Alberto Vargas, MD[16]

A systematic review from 2013-2018, 35 studies

- Conventional imaging
  - CT, Bone Scan and/or MRI and/or
- Next Generation imaging (NGI)
  - PET
  - PET/CT-PET/MR
  - WB MRI

JCO 2020 10;(17) 19631996

Original Investigation

Multiparametric MRI as a Biomarker of Response to Neoadjuvant Therapy for Localized Prostate Cancer–A Pilot Study

Fiona M. Fennessy, MB, BCh, BAO, PhD[1], Andriy Fedorov, PhD[1], Mark G. Vangel, PhD[1], Robert V. Mulkern, PhD[1], Maria Tretiakova, MD, PhD[2], Rosina T. Lis, MD[1], Clare Tempany, MB, BCh, BAO[1], Mary-Ellen Taplin, MD[1]

Rationale and Objectives: To explore a role for multiparametric MRI (mpMRI) as a biomarker of response to neoadjuvant androgen deprivation therapy (ADT) for prostate cancer (PCa).

Materials and Methods: This prospective study was approved by the institutional review board and was HIPAA compliant. Eight patients with localized PCa had a baseline mpMRI, repeated after 6-months of ADT, followed by prostatectomy. mpMRI indices were extracted from tumor and normal regions of interest (TROI/NROI). Residual cancer burden (RCB) was measured on mpMRI and on the prostatectomy specimen. Paired t-tests compared TROI/NROI mpMRI indices and pre/post-treatment TROI mpMRI indices. Spearman's rank tested for correlations between MRI/pathology-based RCB, and between pathological RCB and mpMRI indices.

Results: At baseline, TROI apparent diffusion coefficient (ADC) was lower and dynamic contrast enhanced (DCE) metrics were higher, compared to NROI (ADC: $806 \pm 137 \times 10^{-6}$ vs. $1277 \pm 213 \times 10^{-6}$ mm^2/sec, $p = 0.0005$; K^{trans}: 0.346 ± 0.16 vs. 0.144 ± 0.06 min^{-1}, $p = 0.002$; AUC_{90}: 0.213 ± 0.08 vs. 0.11 ± 0.03, $p = 0.002$). Post-treatment, there was no change in TROI ADC, but a decrease in TROI K^{trans} (0.346 ± 0.16 to 0.188 ± 0.08 min^{-1}; $p = 0.02$) and AUC_{90} (0.213 ± 0.08 to 0.13 ± 0.06; $p = 0.02$). Tumor volume decreased with ADT. There was no difference between mpMRI-based and pathology-based RCB, which positively correlated ($\rho = 0.74-0.81$, $p < 0.05$). Pathology-based RCB positively correlated with post-treatment DCE metrics ($\rho = 0.76-0.70$, $p < 0.05$) and negatively with ADC ($\rho = -0.79$, $p = 0.03$).

Conclusion: Given the heterogeneity of PCa, an individualized approach to ADT may maximize potential benefit. This pilot study suggests that mpMRI may serve as a biomarker of ADT response and as a surrogate for RCB at prostatectomy.

Key Words: Androgen deprivation therapy; Multiparametric MRI; Prostate; Biomarker.

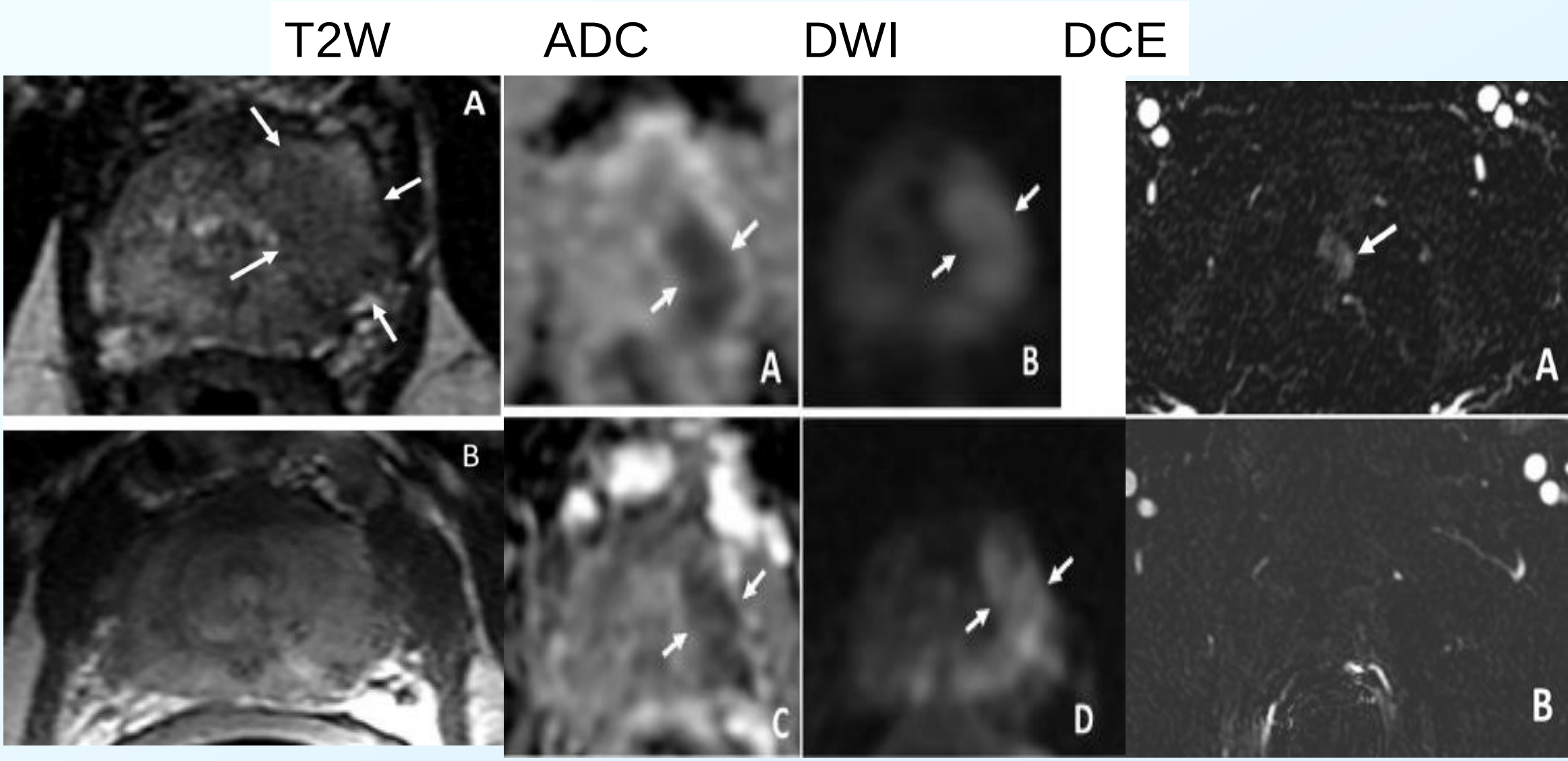
Residual cancer burden

Pathological correlation

- Positive with DCE
- Negative with ADC

Academic Radiology 2019 doi.org/10.1016/j.acra.2019.10.017

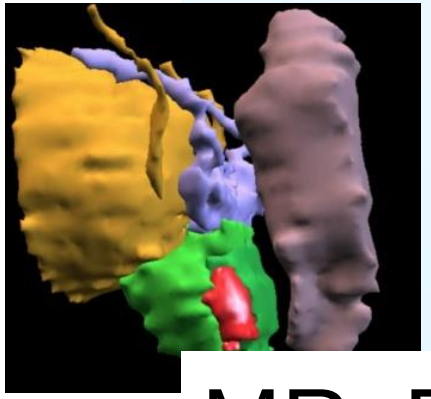
Pre and Post ADT mpMRI

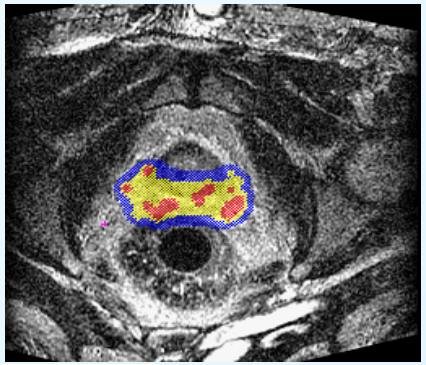


Focal therapy of Prostate Cancer

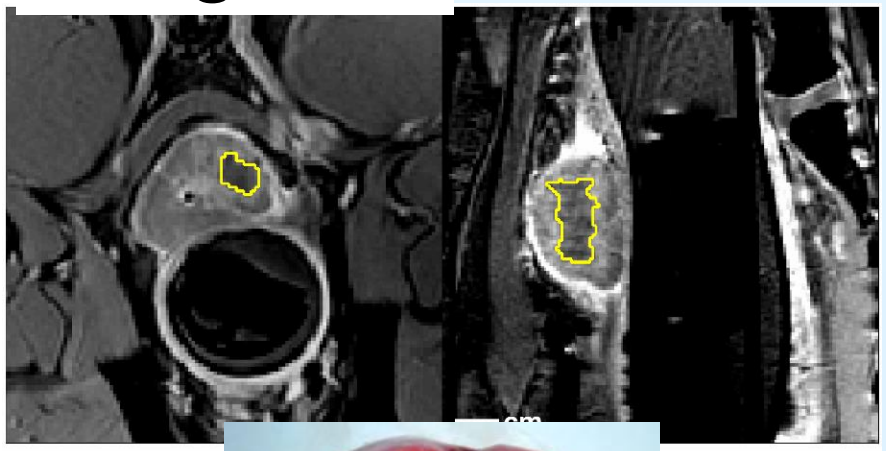
- Sub-total treatment-What does it mean?

  "Male lumpectomy"
  - Hemi-gland
  - Peripheral Zone
  - Focal lesion
- Therapy types
  - Brachytherapy-MRgBrachy
  - Cryoablation
    - UCSF/Columbia/Duke
  - Photodynamic therapy
  - Vascular targeted *TOOKAD*
    - *Laser fibers with photo sensitizer*
      - *Activated in the presence of the laser to cause vascular coag/necrosis*
  - HIFU/MRgFUS



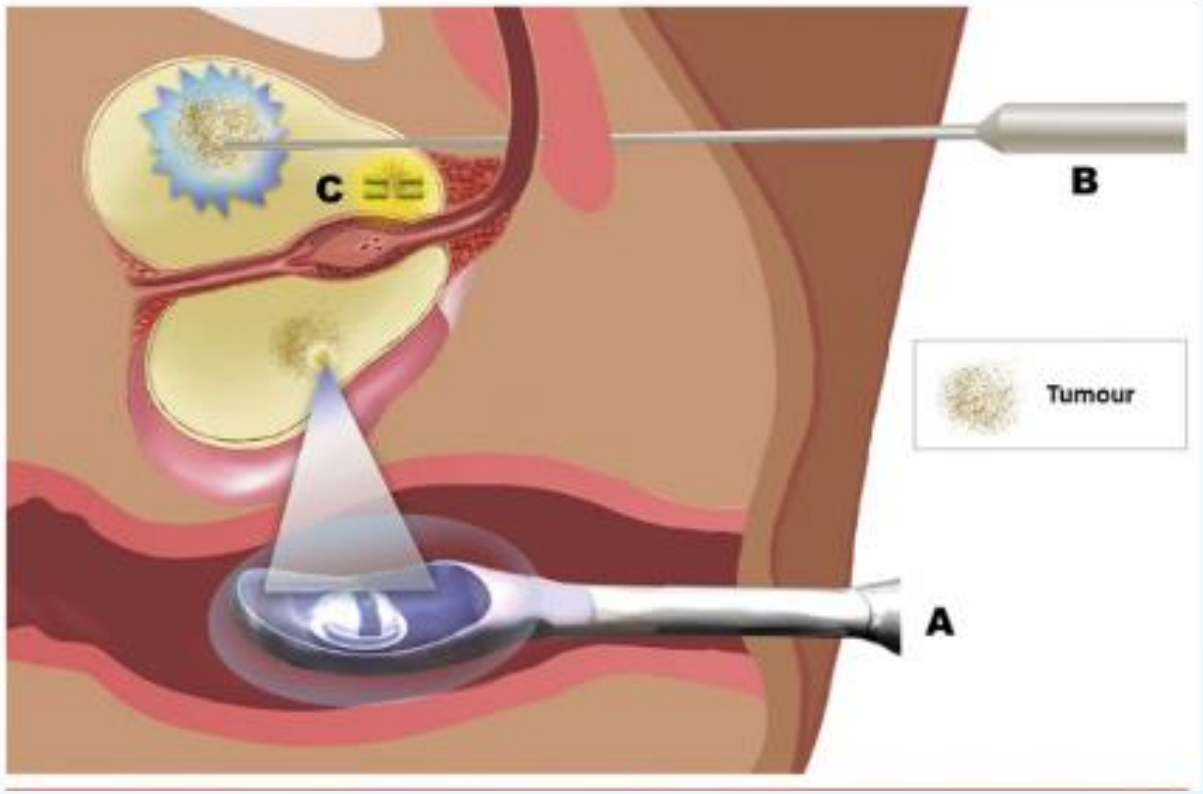


MRgFUS

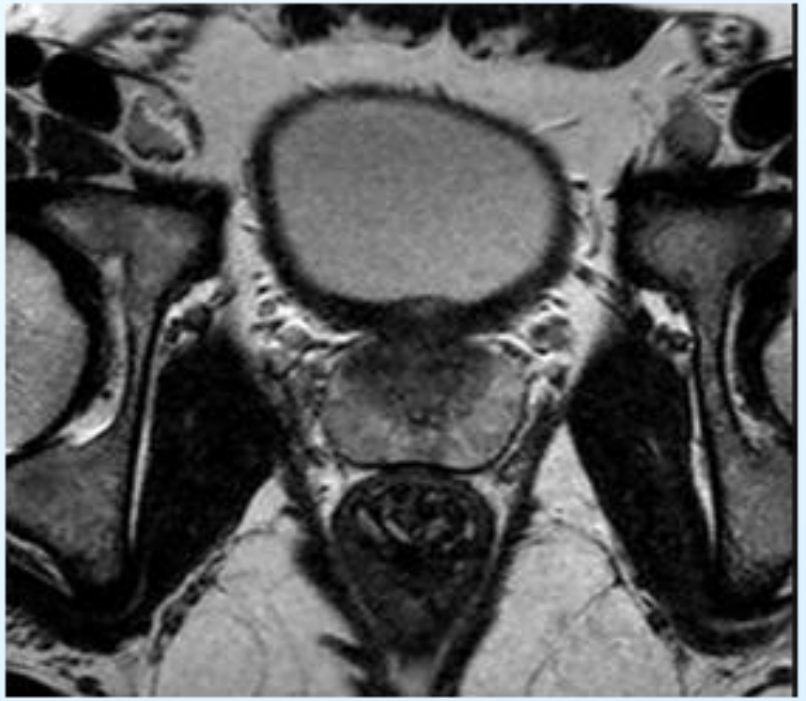


Mc Dannold N, Tempany C

Focal Therapy



How to follow (biopsy vs MRI)?
How to interpret post-treatment MRI?



Ganzer, R., et al, 2018. *Prostate cancer and prostatic diseases*, *21*(2), pp.175-186.
https://radiopaedia.org/cases/normal-prostate-mri-1

Learning objectives

1. To understand current Prostate cancer treatments used for loco-regional disease.
2. To review the appearance of the prostate gland after therapy
3. **To learn how to identify and report post treatment local recurrence**

Current recommended approaches to post focal MRI Target (2024) & PI-FAB (2023)

EUROPEAN UROLOGY 85 (2024) 466–482

available at www.sciencedirect.com
journal homepage: www.europeanurology.com

European Association of Urology

Prostate Cancer – Editor's choice

The Transatlantic Recommendations for Prostate Gland Evaluation with Magnetic Resonance Imaging After Focal Therapy (TARGET): A Systematic Review and International Consensus Recommendations

Systematic review, 24 experts consensus recommendations for acquisition and interpretation of MRI after focal therapy
295 statements drafted by a core group in six categories:

- Timing
- Technical Parameters
- Interpretation
- Structured minimum reporting data set
- Capabilities
- Study minimum report standards

Prostate Imaging after Focal Ablation (PI-FAB): A Proposal for a Scoring System for Multiparametric MRI of the Prostate After Focal Therapy

Francesco Giganti[a,b,*], *Louise Dickinson*[a], *Clément Orczyk*[b,c], *Aiman Haider*[d], *Alex Freeman*[d], *Mark Emberton*[b,c], *Clare Allen*[a,†], *Caroline M. Moore*[b,c,†]

[a] *Department of Radiology, University College London Hospital NHS Foundation Trust, London, UK;* [b] *Division of Surgery & Interventional Science, University College London, London, UK;* [c] *Department of Urology, University College London Hospital NHS Foundation Trust, London, UK;* [d] *Department of Pathology, University College London Hospital NHS Foundation Trust, London, UK*

PI-FAB
Single institution
Based upon local experience

Published in European Association of Urology 2023

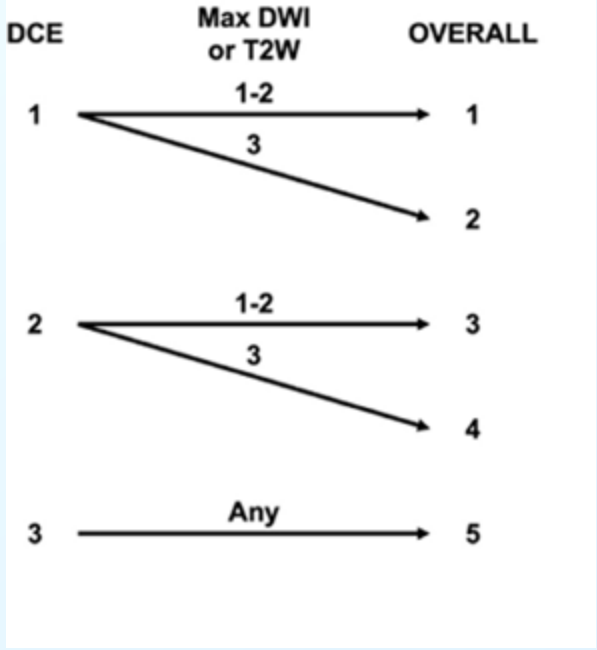
TARGET RESULTS: MRI INTERPRETATION

Systematic Review:

- 20 studies described imaging findings suspicious for recurrence:
  - Most cited: Focal enhancement on DCE sequence (100%)
  - Second most cited: Restricted diffusion restriction on DWI sequence (40%)
  - Focal low/intermediate signal on T2W suspicious in five studies

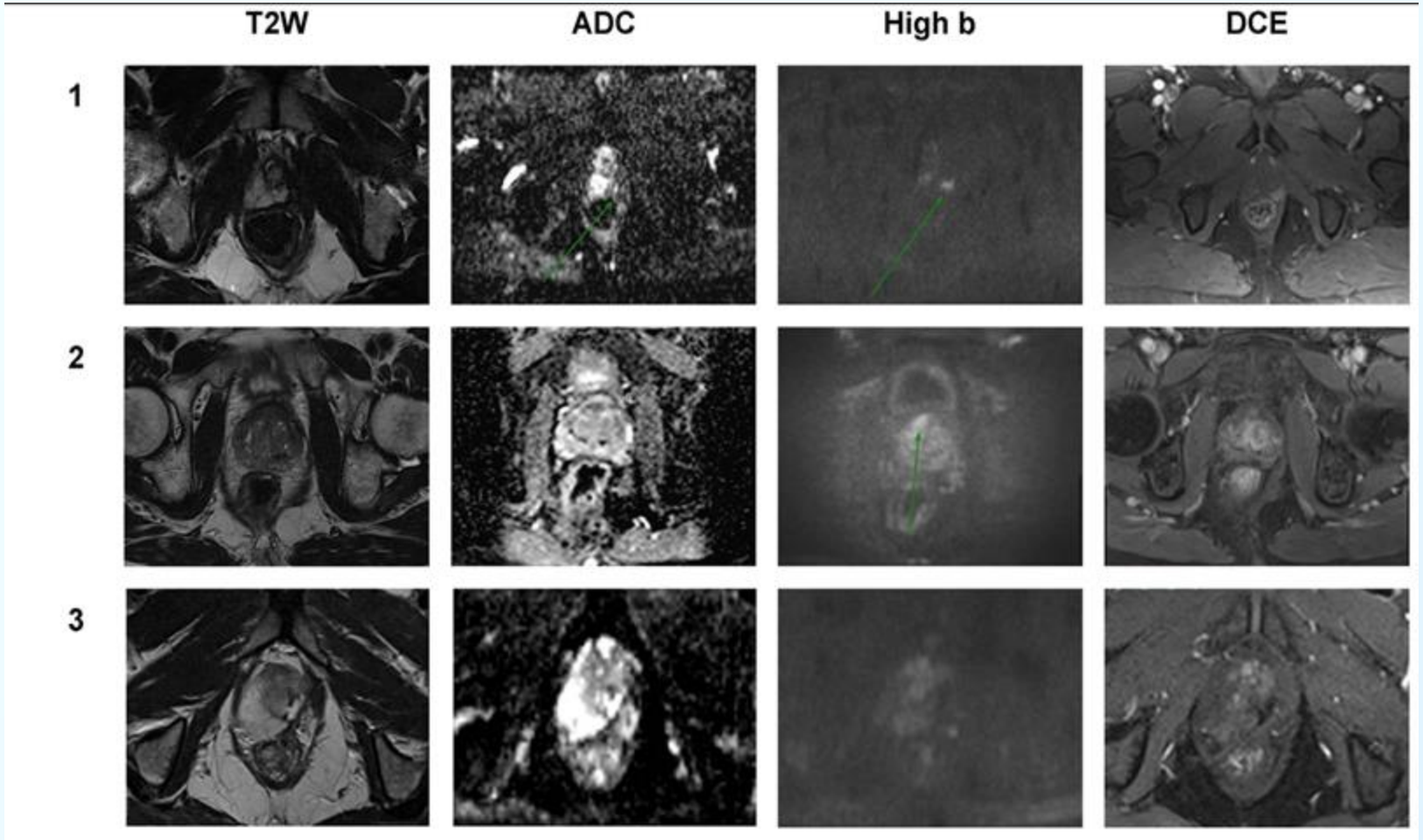
Consensus Recommendations:

- "In field" For ablation zone lesions: DCE is the most important sequence, followed by DWI and T2W, which are joint minor sequences
- "Out of field" Lesions outside of ablation zone: use PI-RADS v2.1 criteria



DCE score	Interpretation	Criteria
1	Non-suspicious	No early enhancement OR Focal late enhancement OR Any other finding not meeting criteria for score 2 or 3
2	Equivocal	Focal nodular mild early enhancement OR Thin linear early enhancement OR Curvilinear early enhancement
3	Suspicious	Focal nodular strong early enhancement

TARGET RESULTS: MRI INTERPRETATION



Example 1: Focal lesion with restricted diffusion (DWI 3/3) in the posterior left apex. There is focal early enhancement (DCE 3/3), which would give an overall score of 5/5.

Example 2: Lesion with restricted diffusion (DWI 3/3) in the anterior right transition zone. There is no contrast enhancement (DCE 1/3), giving an overall score of 2/5.

Example 3: No diffusion restriction (DWI 1/3) or enhancement (DCE 1/3) in the ablation zone, giving an overall score of 1/5.

PI-FAB: Prostate Imaging after Focal Ablation

- Prostate Cancer (primary and recurrent disease
  - Intermediate-low signal on T2 Weighted Imaged
  - Increased signal on high B value diffused weighted images (DWI) with corresponding low signal on apparent diffusion coefficient (ADC) map
  - Early enhancement on Dynamic Contrast Enhanced (DCE) images.
- Post treatment changes:
  - Interpretation is rendered challenging by presence of post-treatment fibrosis which demonstrates low signal on T2WI and ADC map
  - DCE images become more relevant in this setting for both peripheral zone and transition zone lesions

PI-FAB

- PI-FAB proposes a 3-point scale, assessing MRI sequences in sequential order:
  1. DCE sequences
  2. DWI – High B value first, followed by ADC
  3. T2WI
- Essential to know the following information:
  - Date of treatment
  - Ablation modality
  - Tumor Burden (Gleason grade group, maximum cancer core length)
  - PSA and PSA kinetics
  - **Pre treatment images**

PI-FAB

Assess in sequential order

DCE	DWI (high b value)	DWI (ADC map)	T2-WI	Action	PI-FAB score	Clinical management
-	-	+	Hypointense +		PI-FAB 1	Continue monitoring
+	-	+	Hypointense +	Refer to pre-treatment imaging for DCE sequences comparison	PI-FAB 2	Correlation with PSA kinetics (and follow up MRI) *(biopsy should be considered if PSA is rising)*
+	+	+	Hypointense +		PI-FAB 3	Biopsy

* if linear and not at the site of the original tumour

** early focal enhancement (> 3 mm) within the ablated zone similar to the original tumour and/or PI-FAB 2 focus that has increased in size

Legend	
DCE (+)	Focal **early enhancement**
DWI *high b value* (+)	Focal **hyper**intensity
DWI *ADC map* (+)	Focal **hypo**intensity
T2-WI (+)	Focal **hypo**intensity

PI-FAB

No enhancement or elevated signal on DWI → PI-FAB 1: Likely fibrosis

Focal enhancement alone (no elevated DWI signal):

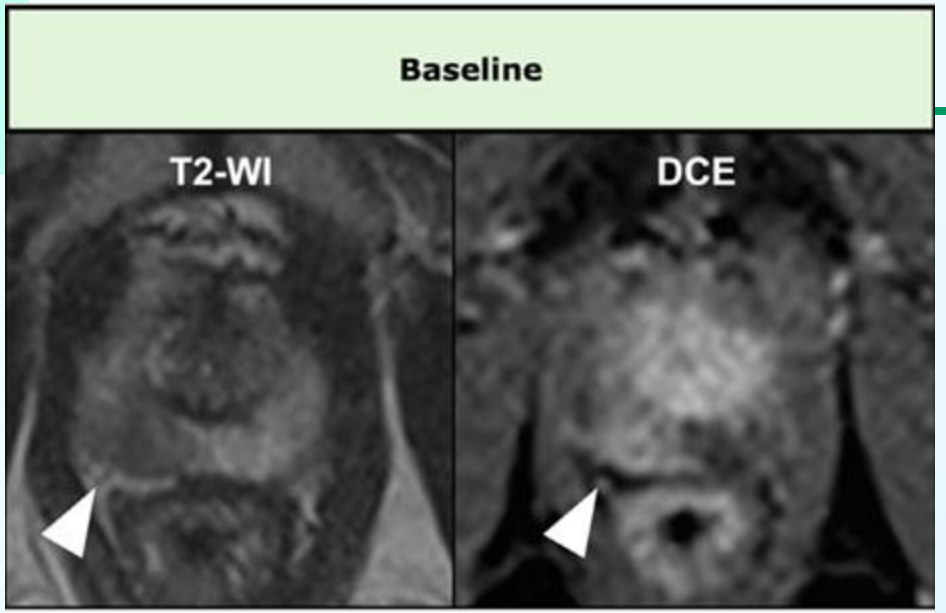
- Linear and not at site of tumor → Likely vessel or inflammation → PI-FAB 1
- ≤3mm and at site of original tumor → PI-FAB 2
- >3mm at site of original tumor or edge of ablation cavity → PI-FAB 3
- Growing PI-FAB 2 → PI-FAB 3

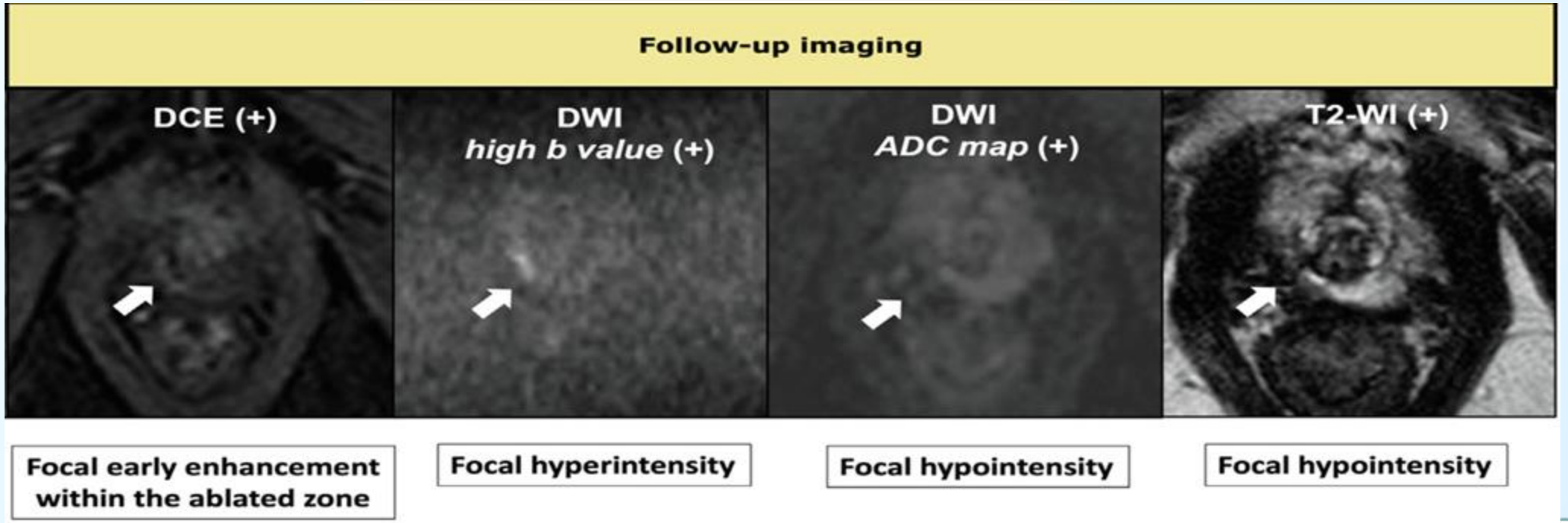
Enhancement and elevated signal on DWI → PI-FAB 3: High suspicion for recurrent or residual disease.

IMPORTANT:

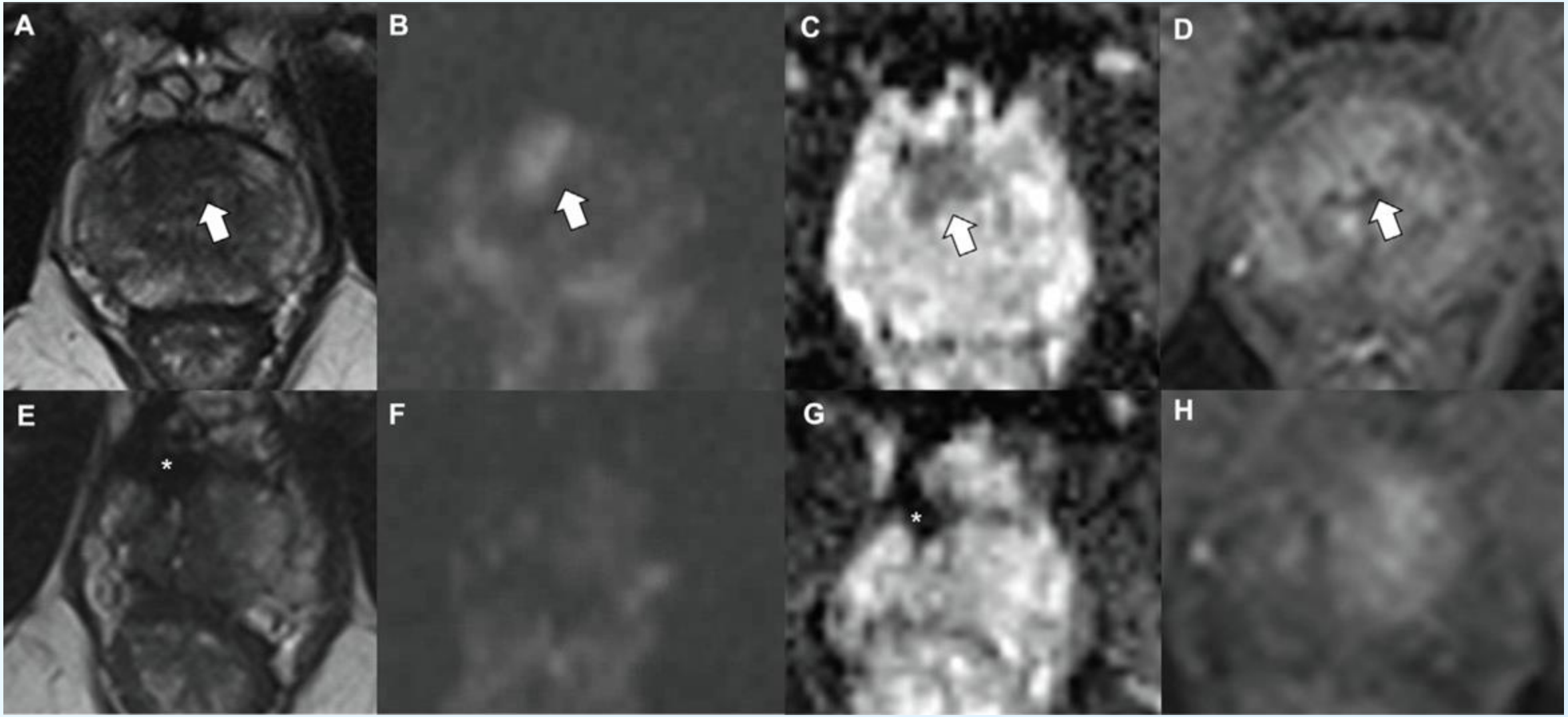
- In field recurrence can only be assessed once necrosis has resolved, minimum is 3 months.
- Practice at UCL: MRI at 12 months if PSA below baseline, if not below baseline then MRI at 6 months.
- The untreated prostate should be scored with conventional methods i.e. PI-RADS.

PI-FAB 3

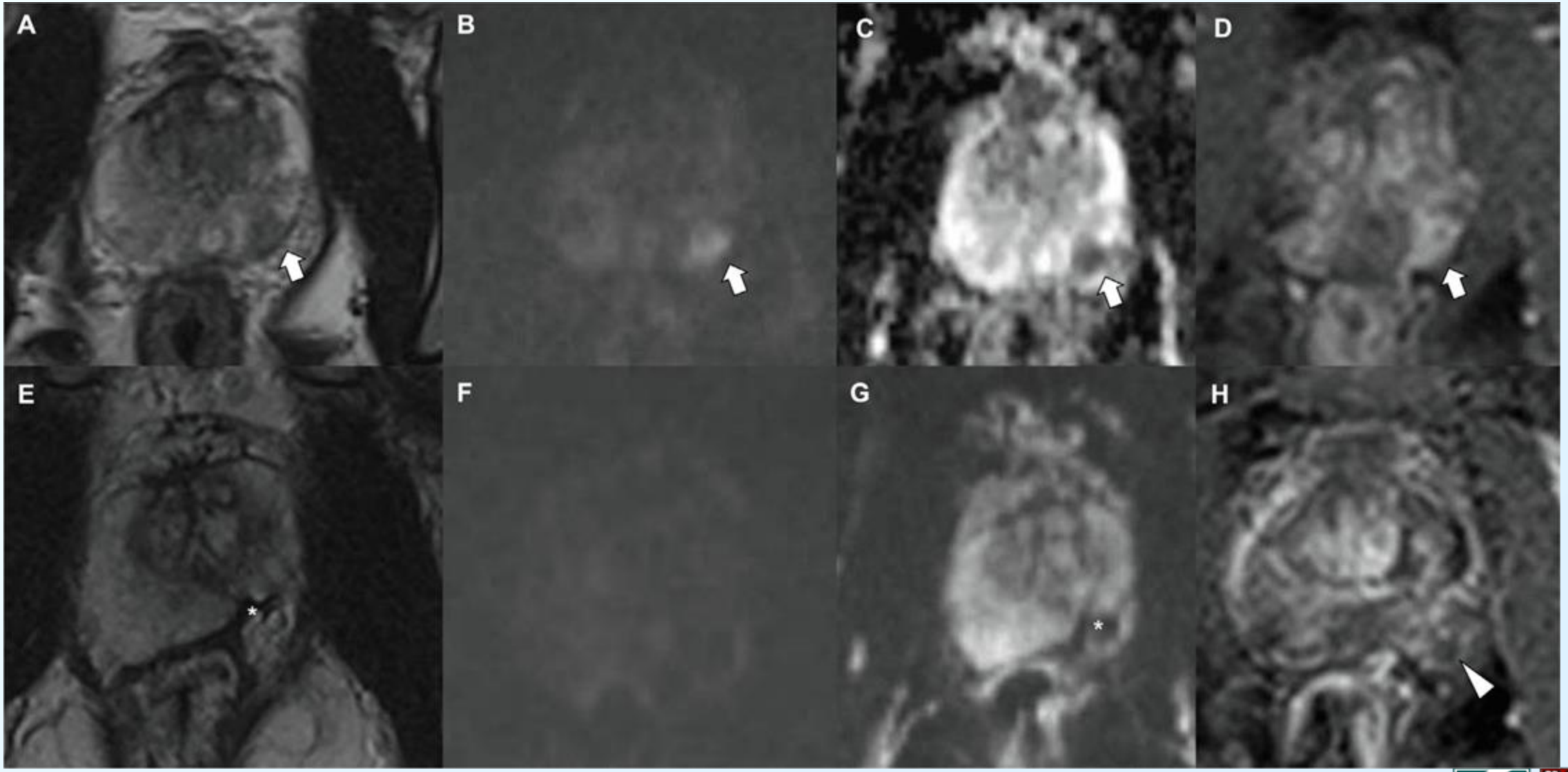




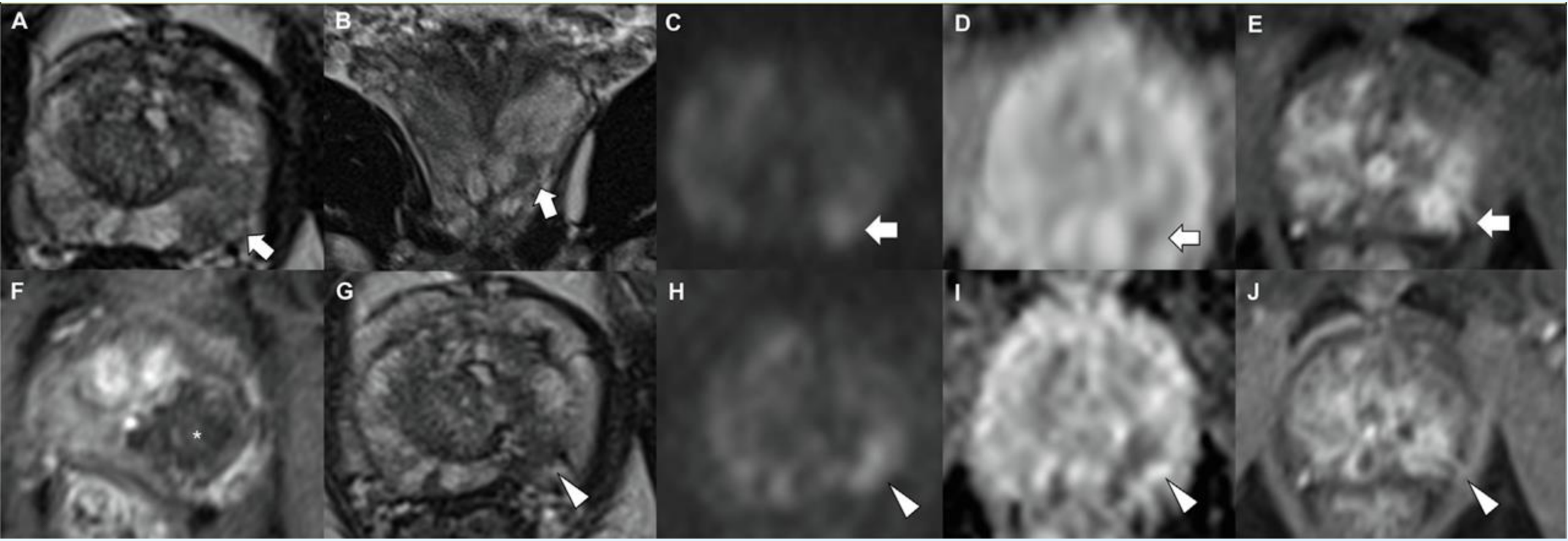
PI-FAB 1



PI-FAB 2



PI-FAB 3



Early post treatment MRI at 3-7 days. To establish if any residual disease/to assess ablation zone.

Image Quality

- Although no specific requirements exist for PI-FAB, it is recommended that all examinations adhere to PIRADS v2.1 minimal technical requirements and have a PI-QUAL score of at least 4 (adequate diagnostic quality).

Table 2.

Assessment of the diagnostic quality of multiparametric MRI scans using the PI-QUAL score

PI-QUAL score	Criteria	Clinical implications
1	All mpMRI sequences are below the minimum standard for diagnostic quality	It is NOT possible to rule in all significant lesions[a]
2	Only one mpMRI sequence is of acceptable diagnostic quality	It is NOT possible to rule out all significant lesions[a]
3	At least two mpMRI sequences taken together are of diagnostic quality	It is possible to rule in all significant lesions
		It is NOT possible to rule out all significant lesions
4	Two or more mpMRI sequences are independently of diagnostic quality	It is possible to rule in all significant lesions
5	All mpMRI sequences are of optimal diagnostic quality	It is possible to rule out all significant lesions

Giganti F, Allen C, Emberton M, Moore CM. Prostate imaging quality (PI-QUAL): a new quality control scoring system for multiparametric magnetic resonance imaging of the prostate from the PRECISION trial. Eur Urol Oncol. 2020;3(5):615–619. doi: 10.1016/j.euo.2020.06.007.

PI-FAB Summary

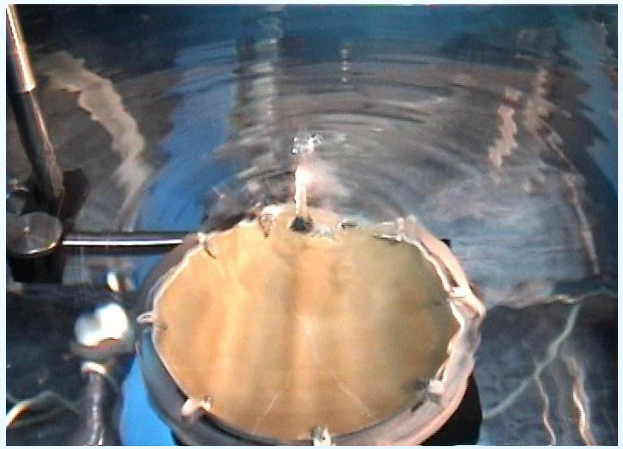
- PI-FAB : A framework for reporting the appearance of the prostate gland after focal ablation.
- All forms of ablation including cryoablation, HIFU, IRE etc.
- Further research and collaboration is needed to assess the utility/accuracy
- Limitations:
  - Primary lesions which are not DCE+
  - Only HIFU
  - Single center study based on expert opinion alone
  - Methodology lacking details
  - Not validated
  - Non MRI visible disease (similar to PI-RADS)

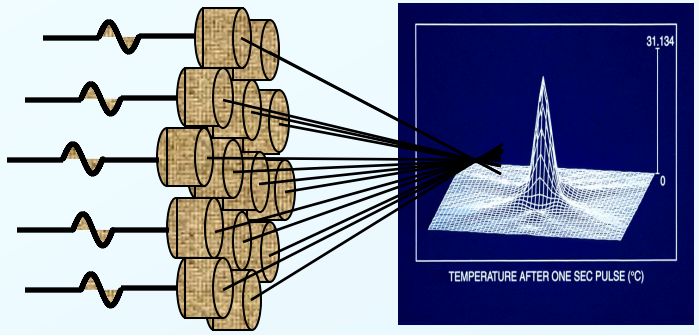
TARGET versus PI-FAB

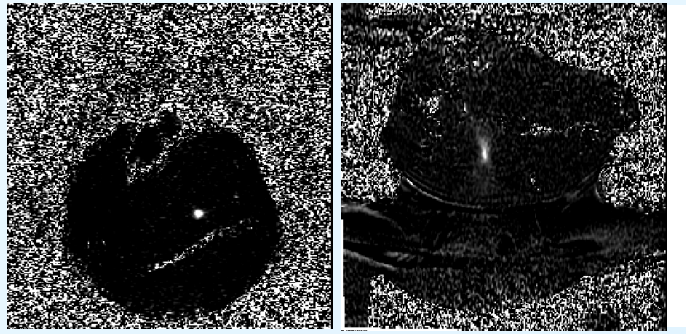
- TARGET has a more robust methodology
  - Multiple centers
  - Literature review
  - Detailed methodology
- NEITHER are validated

- TARGET proposes a 5-point scale ; PI-FAB proposes a 3-point scale
- Limitation of PI-FAB is *the setting of non-DCE + primary* lesion

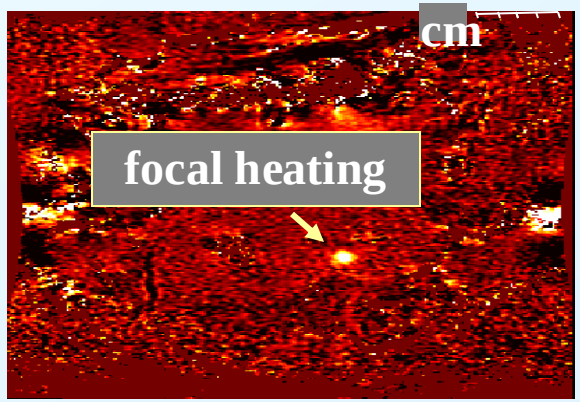
Magnetic Resonance Guided Focused Ultrasound Surgery

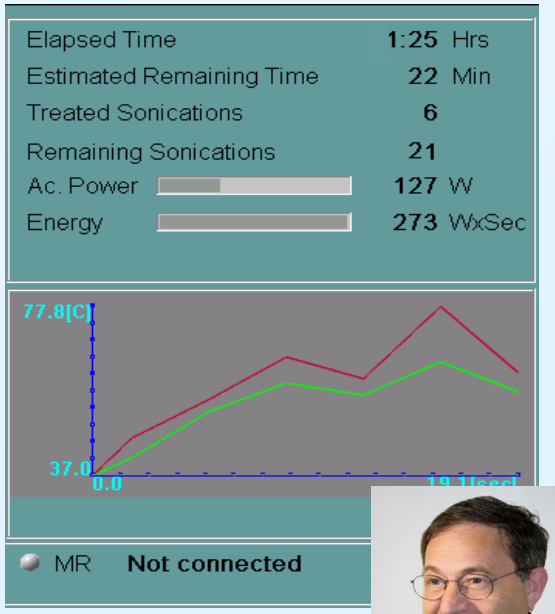




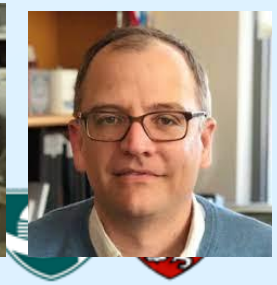


MR thermometry
Real-time feed back





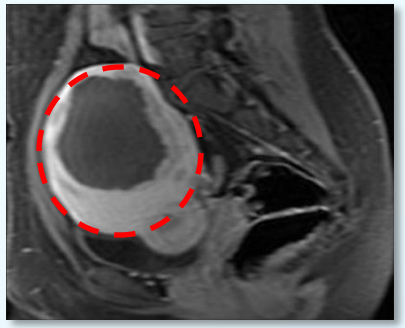
Wood & Lomis 1928
Hindman 1966
Parker Med Phys 1983
Cline MRM 1993
Matusmoto JMRI 1994
Kuroda MRM 1997
Clement 2000



MRgFUS devices

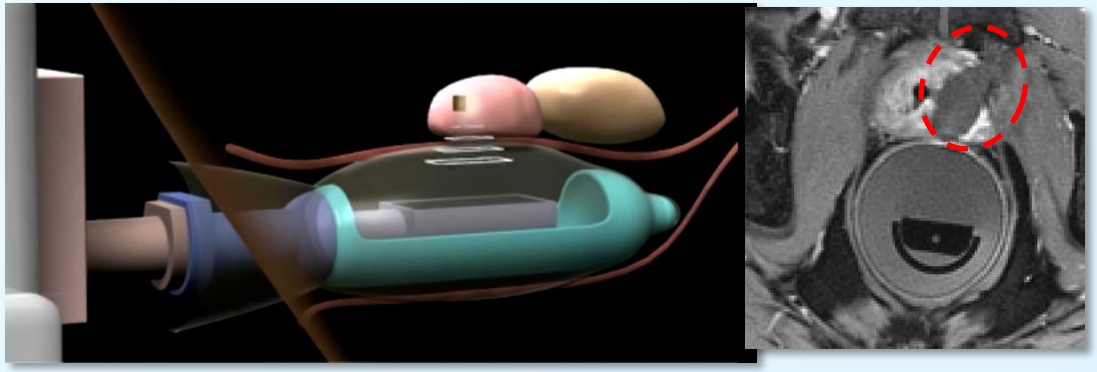
"Body" systems: uterine fibroid, breast, bone

Robotics + phased array integrated into MRI table



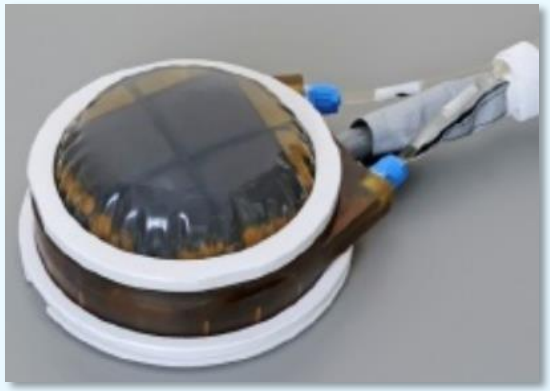
Transrectal probe: Prostate cancer

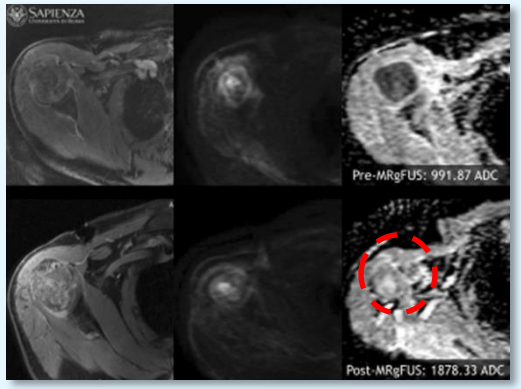
Robotics + 1000 element phased array



Conformal bone system: bone metastases

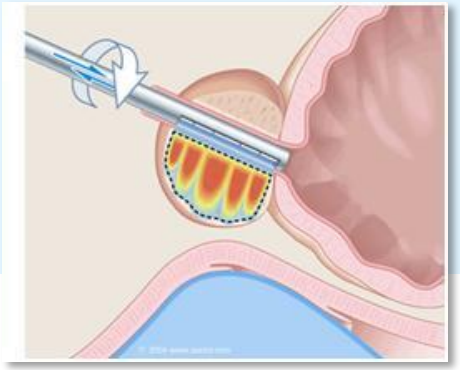
1000 element phased array only; MRI tracking coils

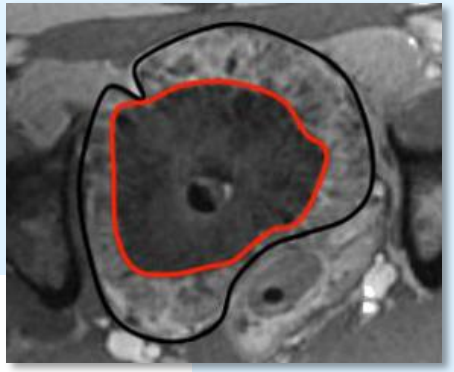




Transurethral: Prostate cancer

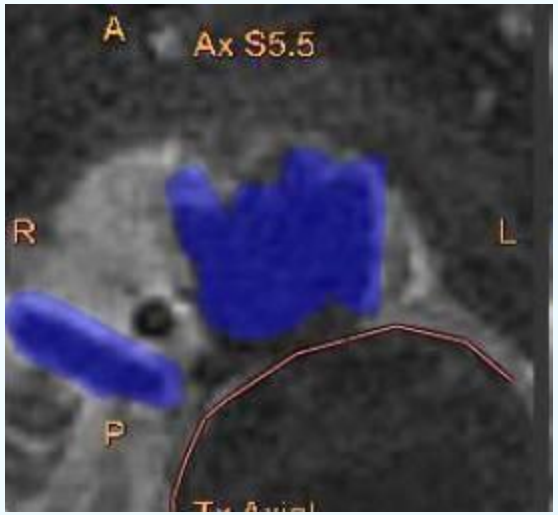
Unfocused transducer + MRI-compatible motor





Initial MRgFUS Prostate Ablation Pre-clinical Results

WS expected dose

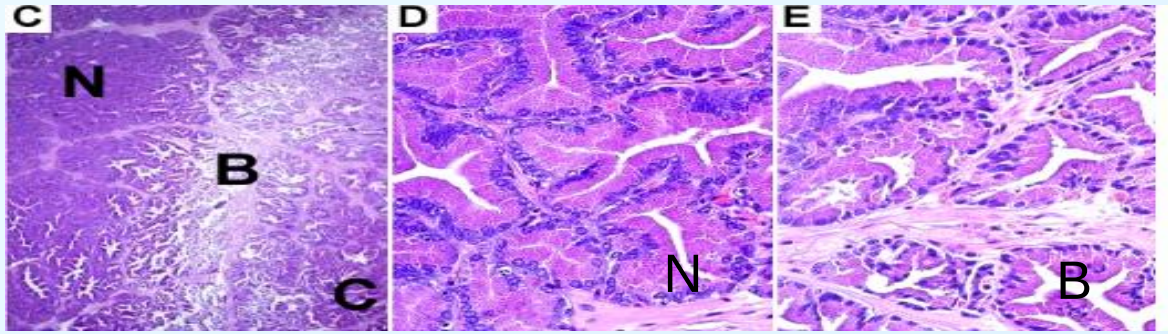


Non-perfused volume, T1w+contrast imaging

TTC stained tissue

McDannold

H&E



The results show a good correlation between expected dose and NPV and similarity to the TTC stained tissue:

Tempany 5R01CA109246

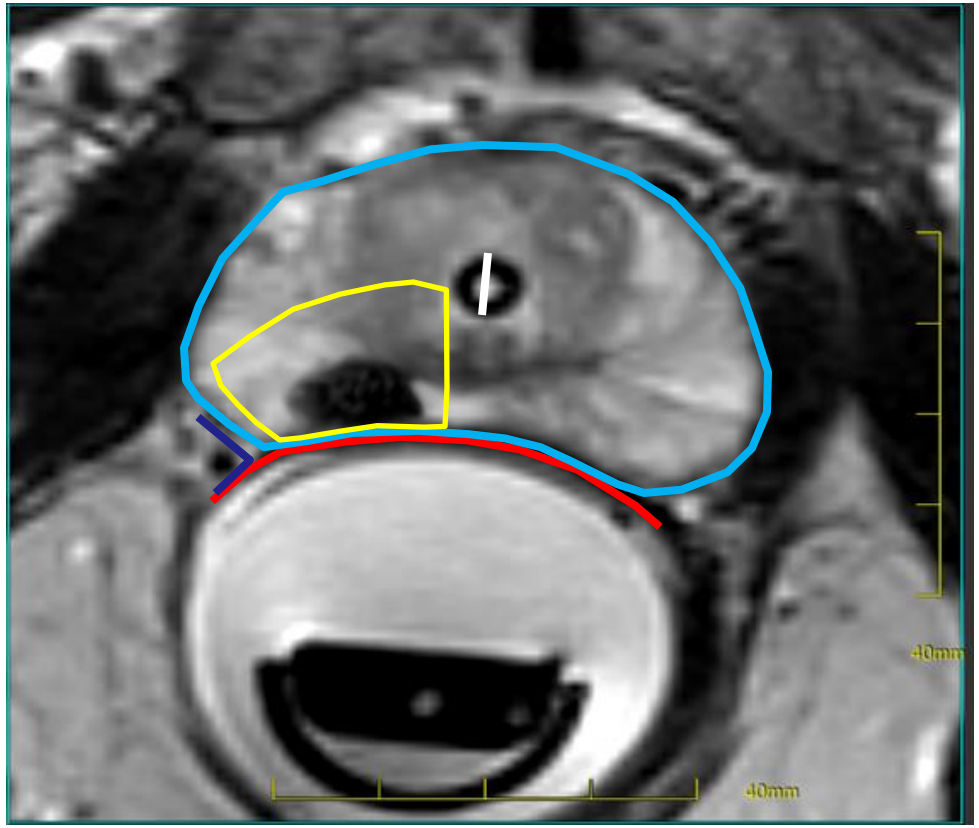
MRgFUS

Non invasive therapy platform combining two proven technologies - HIFU and MRI.

The Focused Ultrasound generates heat at the focal point to ablate the target tissue.

The MRI enables:

1) **Identify target and surrounding tissue**



Rectal wall

Prostate capsule

Region of Treatment

Nerve bundle

Urethra

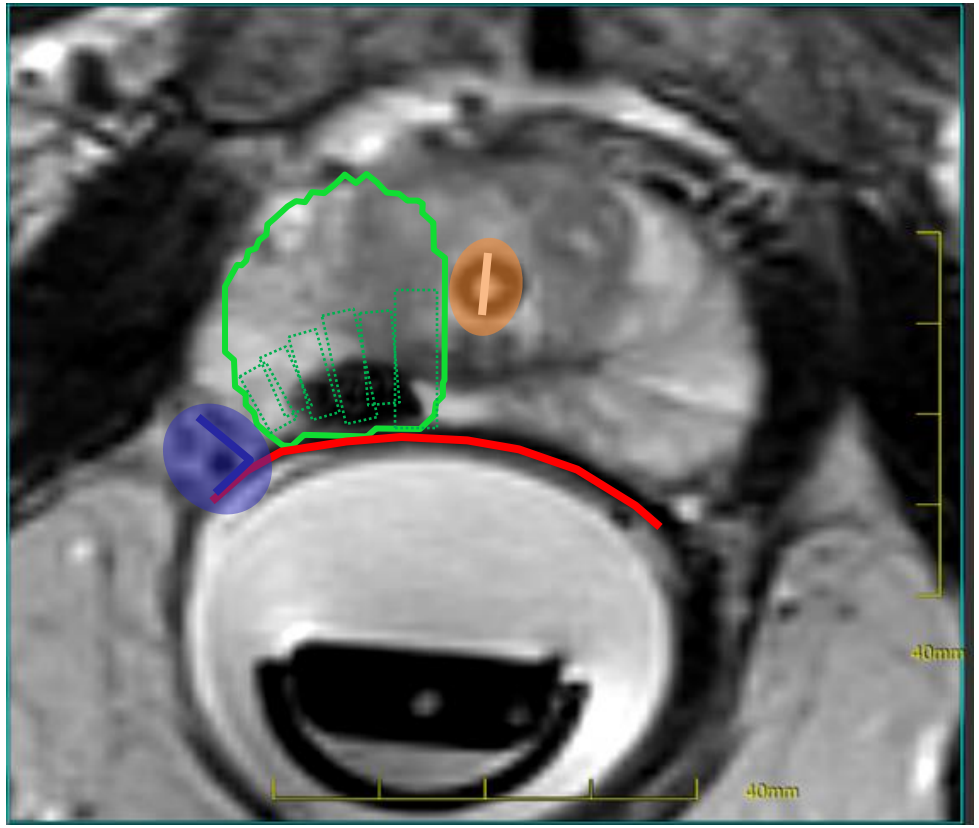
Magnetic resonance imaging-guided ultrasound ablation for prostate cancer
A contemporary review of performance. Alabousi M and Ghai S (2023) Front. Oncol.

Non invasive therapy platform combining two proven technologies - HIFU and MRI.

The Focused Ultrasound generates heat at the focal point to ablate the target tissue.

The MRI enables:

1) Identify target and surrounding tissue
2) **Avoid nearby sensitive structures**

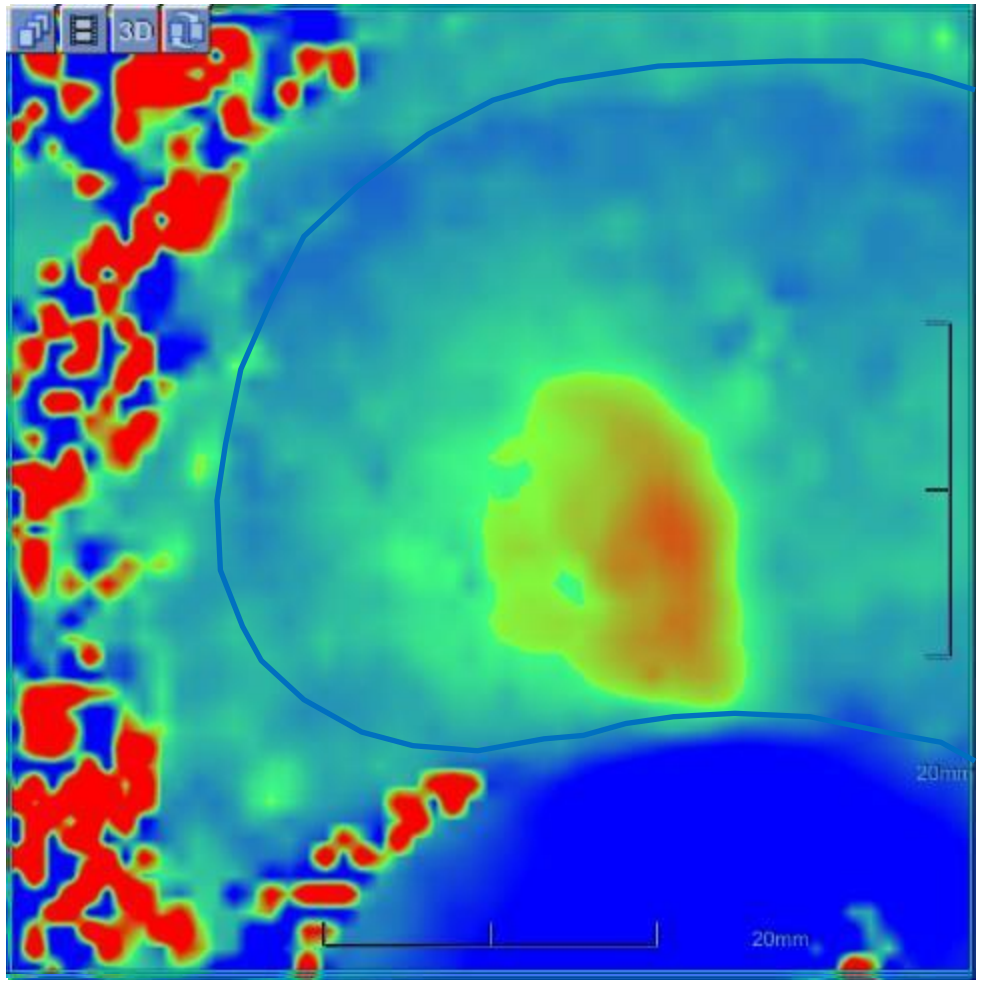


Non invasive therapy platform combining two proven technologies - HIFU and MRI.

The Focused Ultrasound generates heat at the focal point to ablate the target tissue.

The MRI enables:

1) Identify target and surrounding tissue
2) Avoid nearby sensitive structures
3) **Real-time thermometry to monitor the treatment**

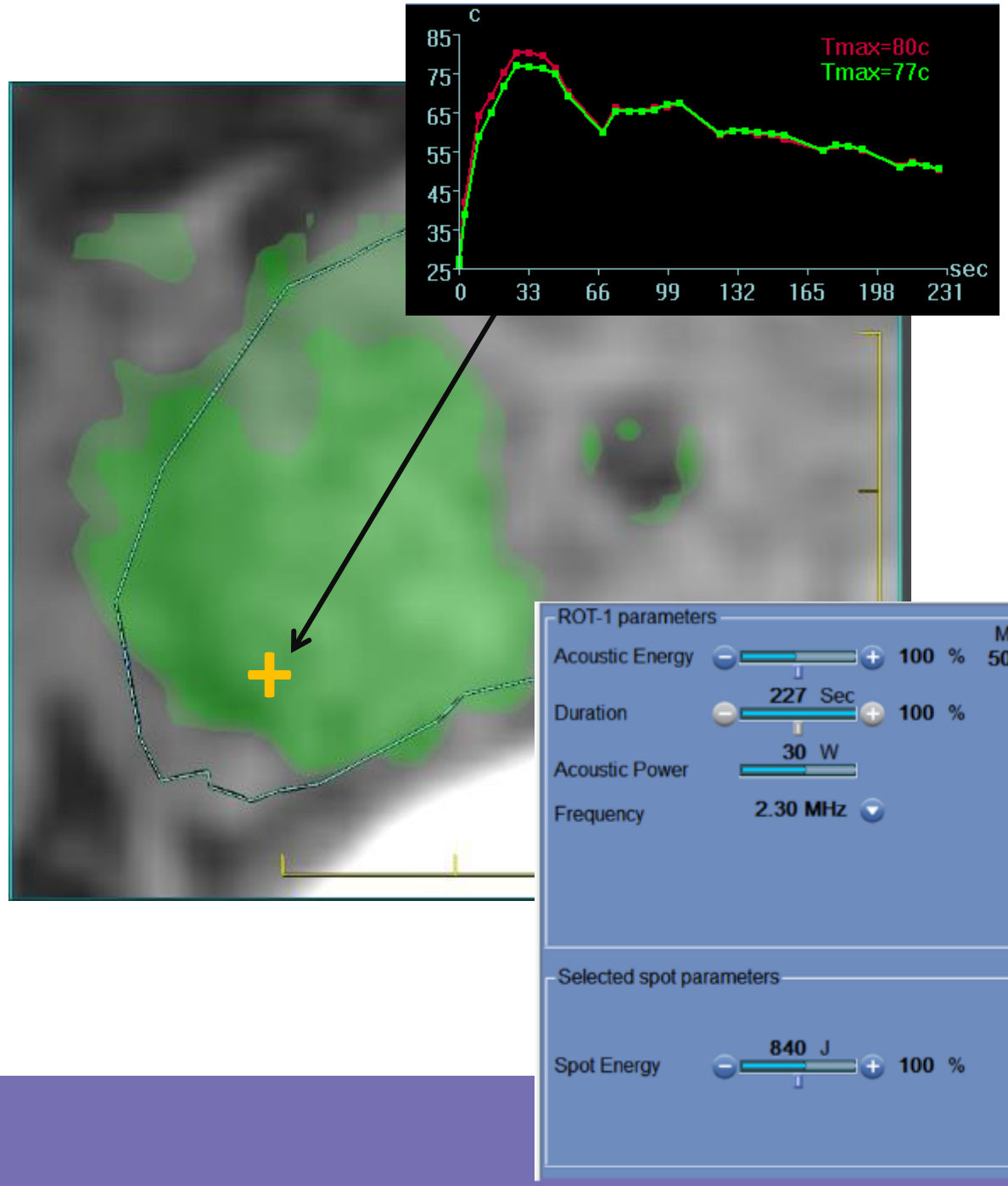


Non invasive therapy platform combining two proven technologies - HIFU and MRI.

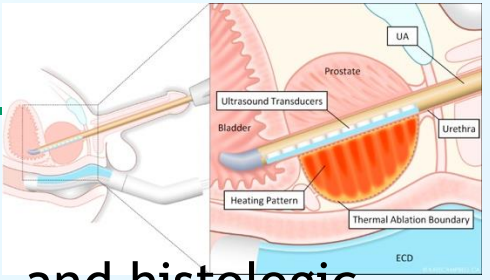
The Focused Ultrasound generates heat at the focal point to ablate the target tissue.

The MRI enables:

1) Identify target and surrounding tissue
2) Avoid nearby sensitive structures
3) Real-time thermometry to monitor the treatment
4) **Personalize the treatment**

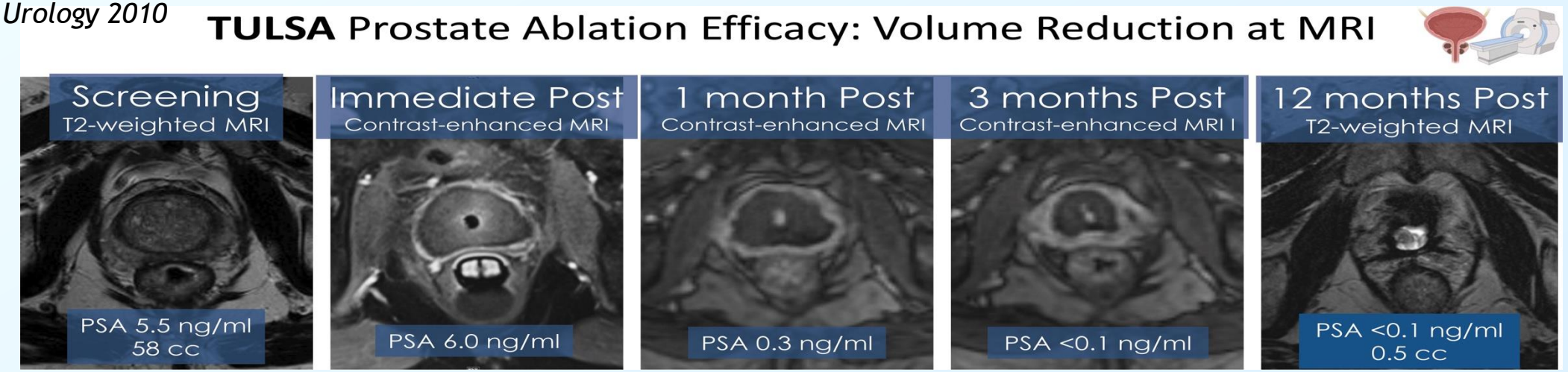


Transurethral MRgFUS



- Thermal coagulation was successful-correlation between anatomical, thermal, and histologic images was ≤3 mm.
- Treatment time was <30 minutes. No thermal damage to rectal tissue was observed.

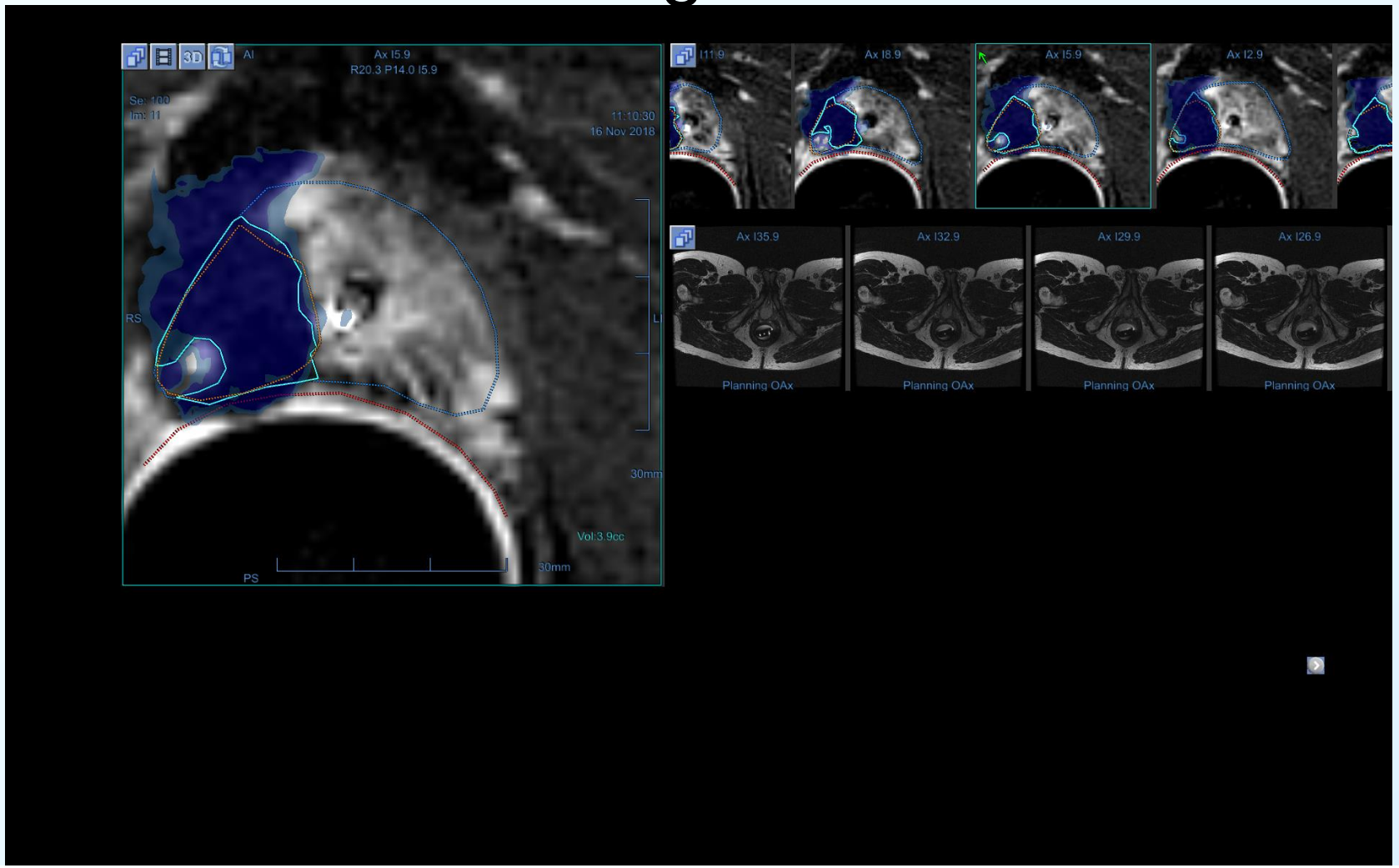
Siddiqui Urology 2010



Sailer A. 2022

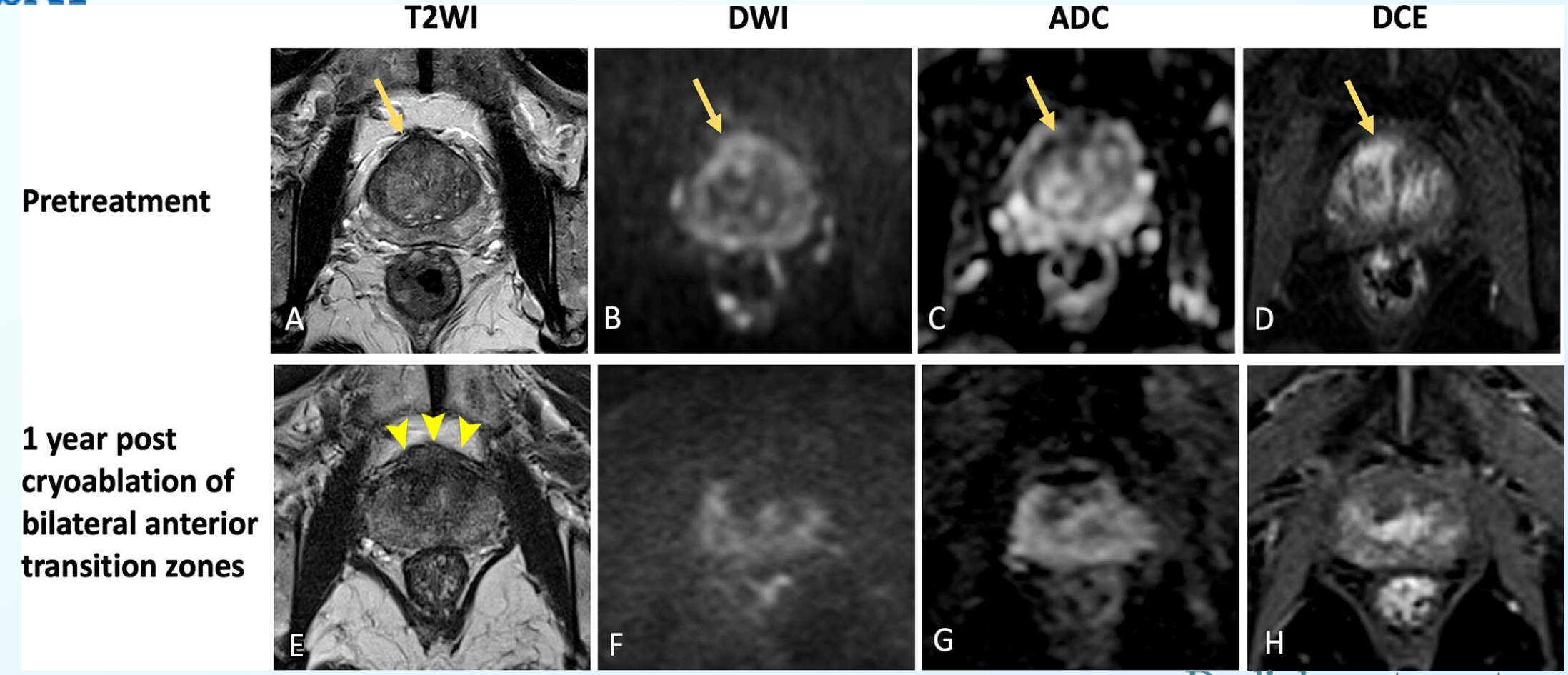
RadioGraphics

MRgFUS



Focal area untreated- always check treatment imaging

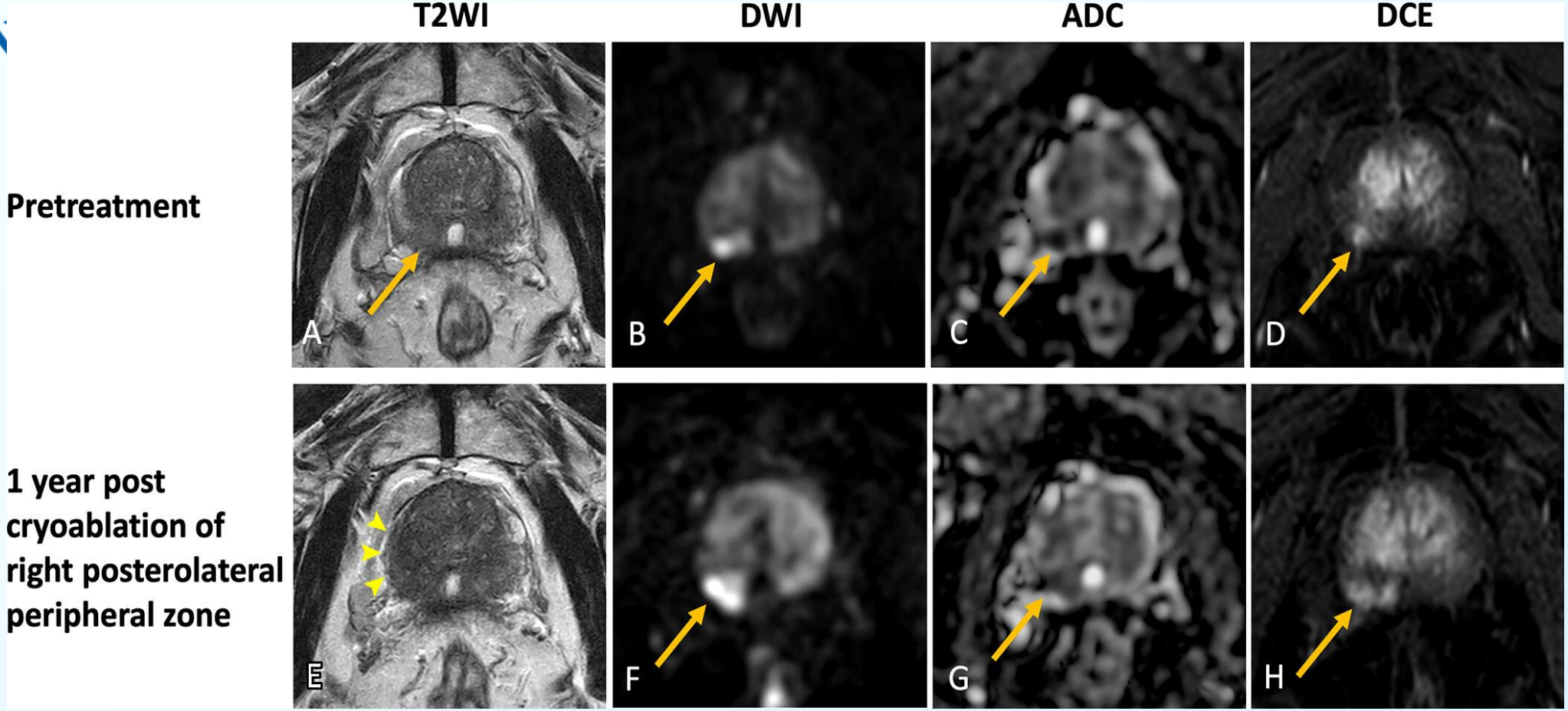
Post focal cryotherapy



Radiology: Imaging Cancer

Lai AL. Published Online: February 21, 2025
https://doi.org/10.1148/rycan.240269

Post focal cryotherapy In field recurrence



Radiology: Imaging Cancer

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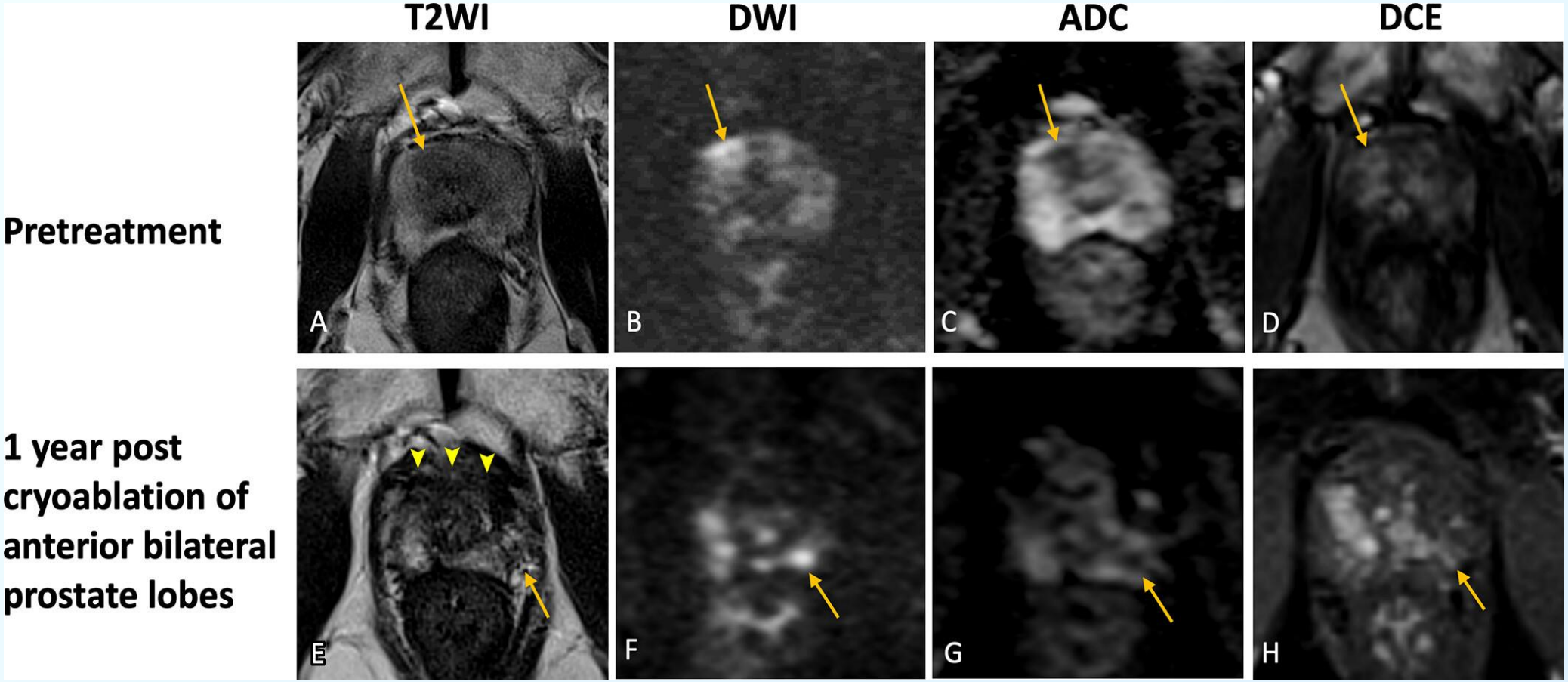
Out of field recurrence



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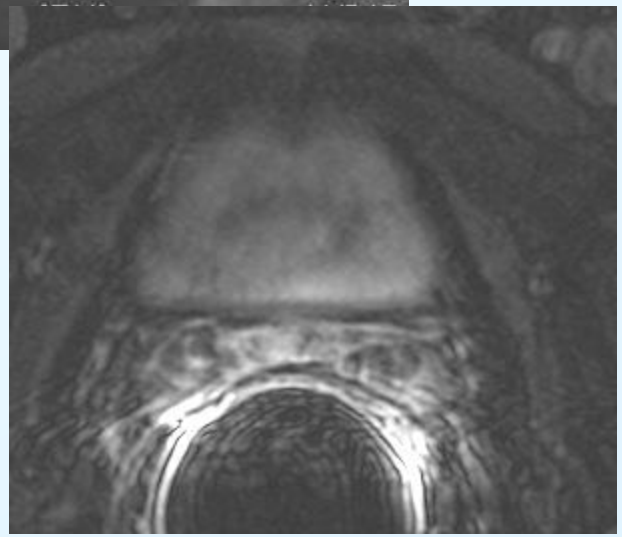
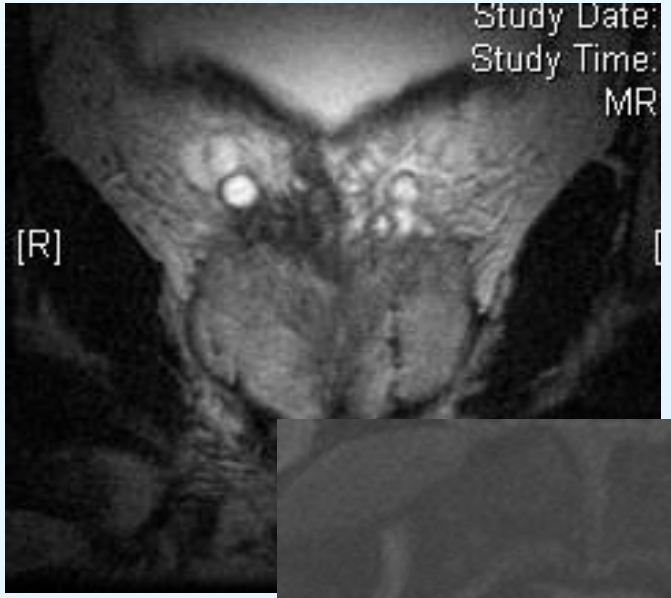
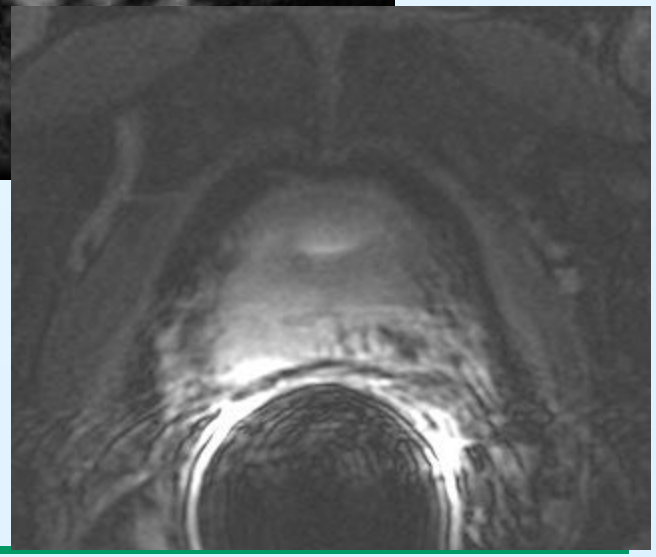
Post Brachytherapy rising PSA





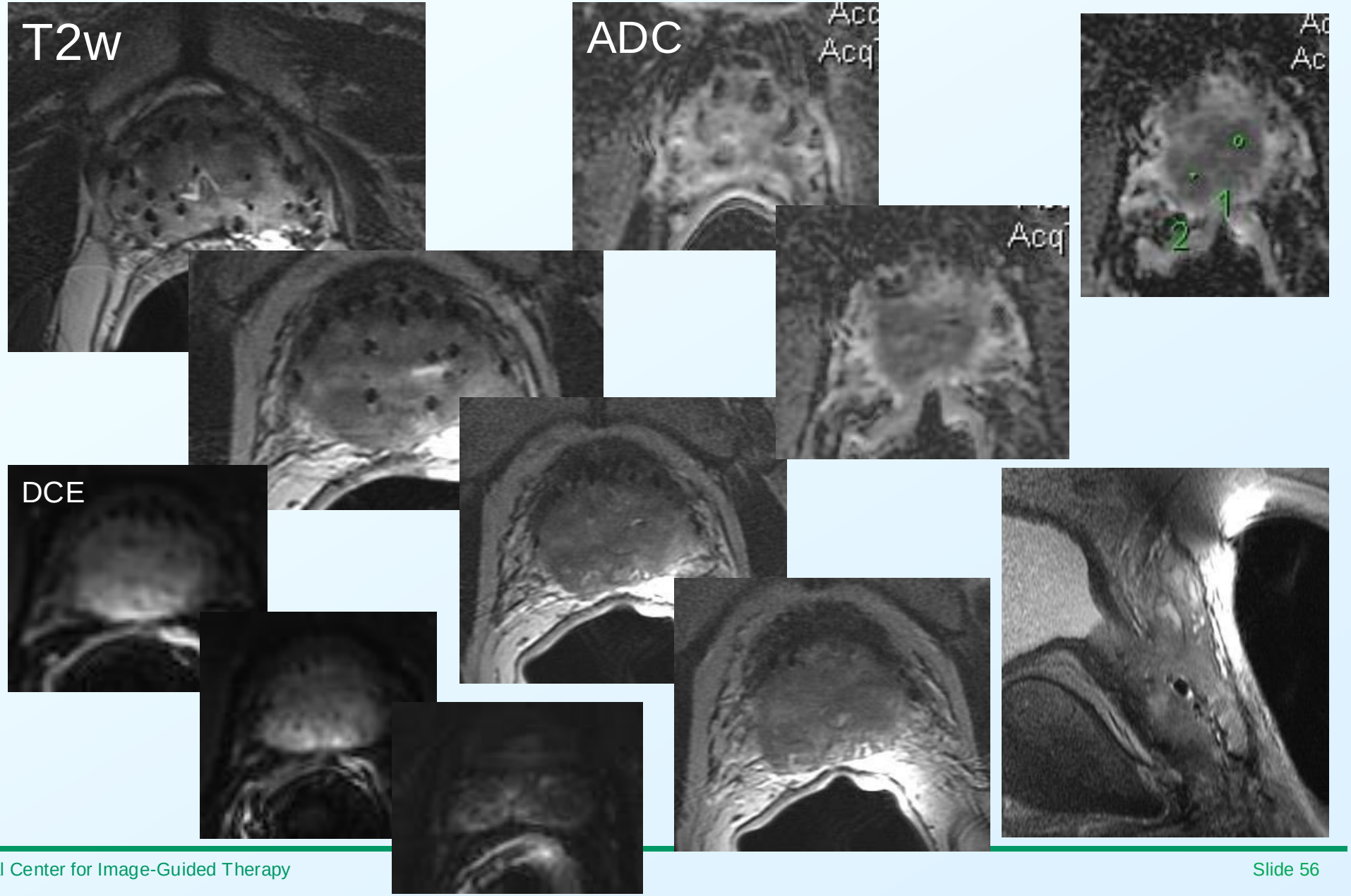


MR findings

Prostate cancer T3C

Left tumor, with SV invasion –enhances with Gad

Post brachytherapy implant rising PSA

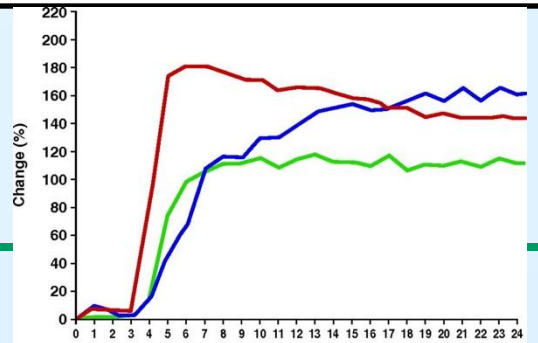


Focal lesion?

Yes NO

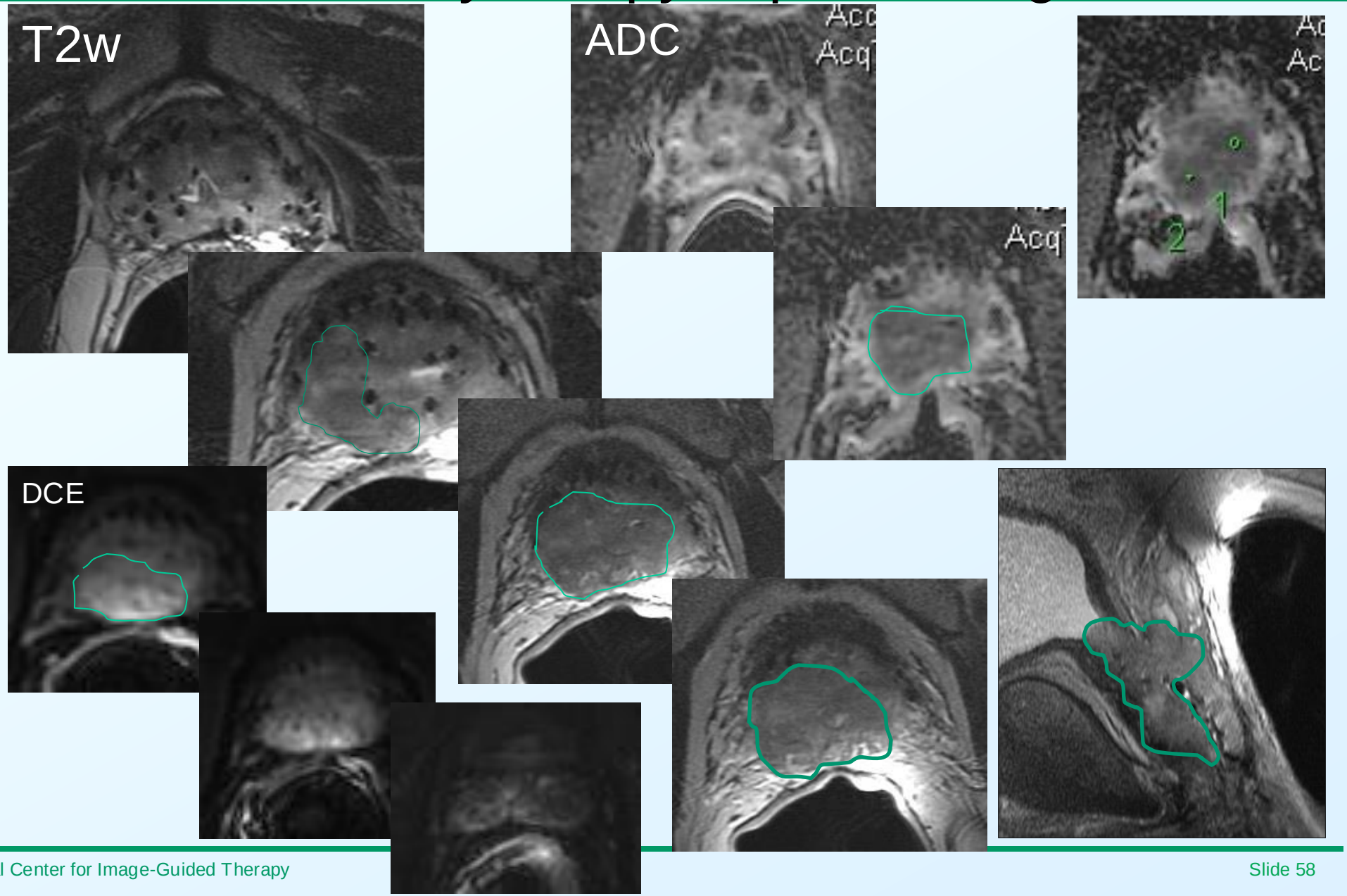
Right TZ & PZ mid Gland

LOW T2W-paucity of seeds
DWI FOCAL High SI
ADC 800
Early enhancement/wash-out

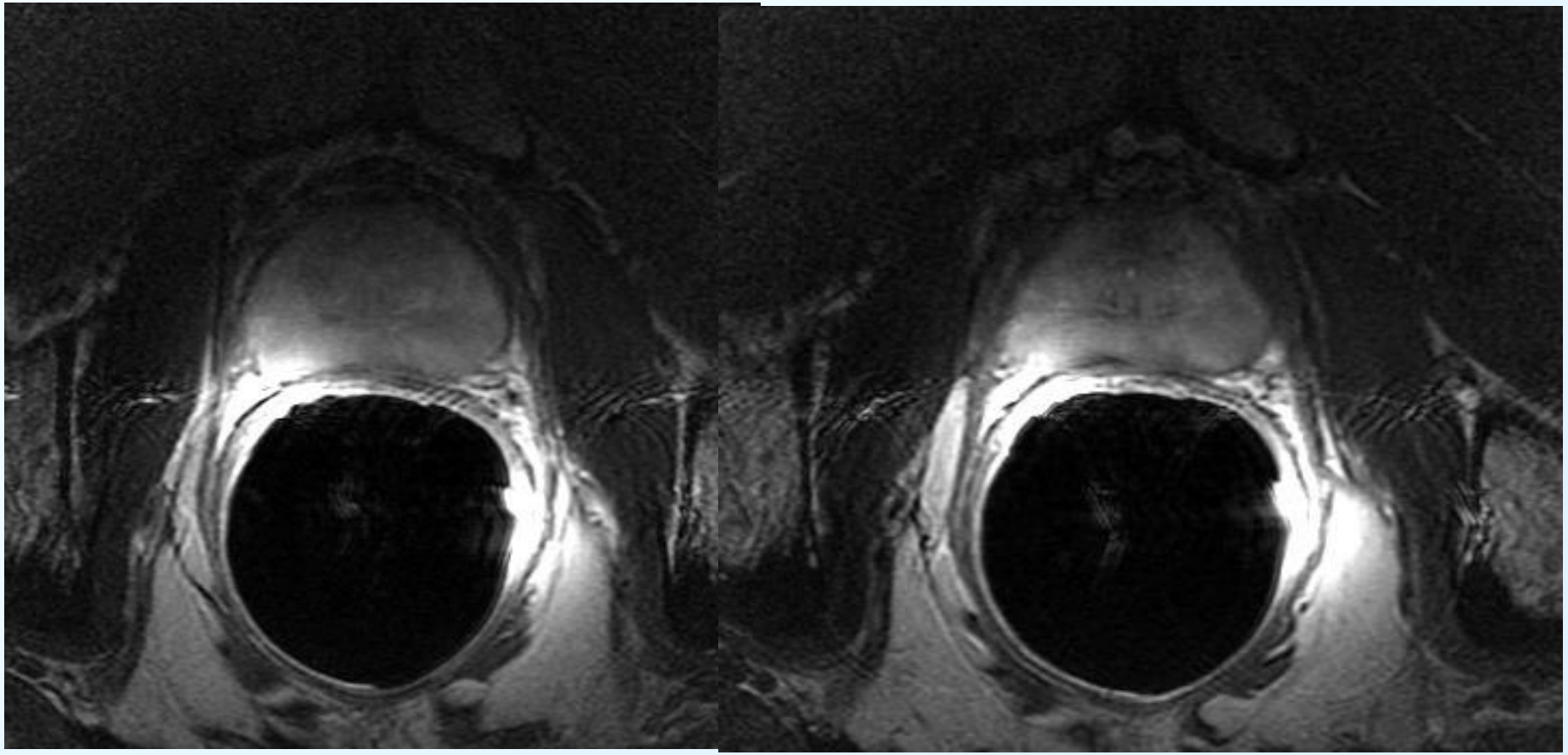


Dx left focal tumor intermediate grade

Post brachytherapy implant rising PSA

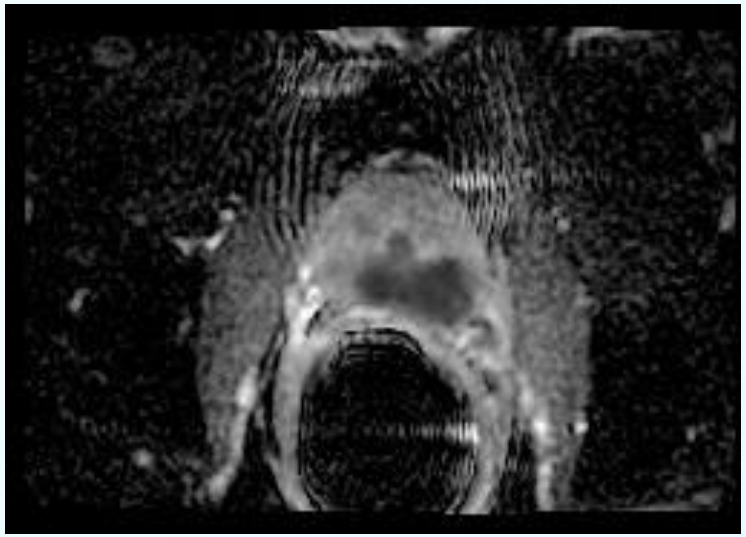


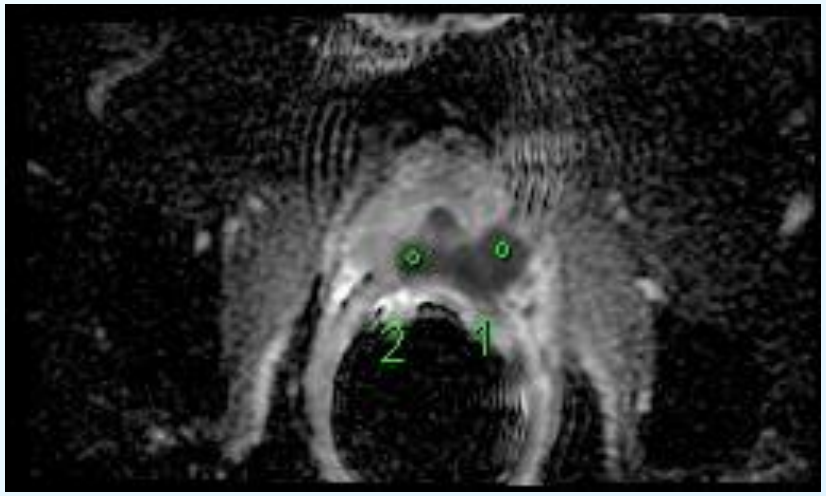
Post EBRT



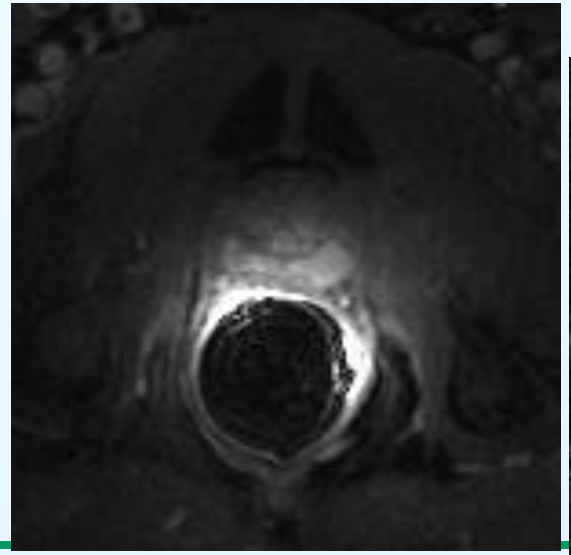
Abnormal low T2W signal on left side

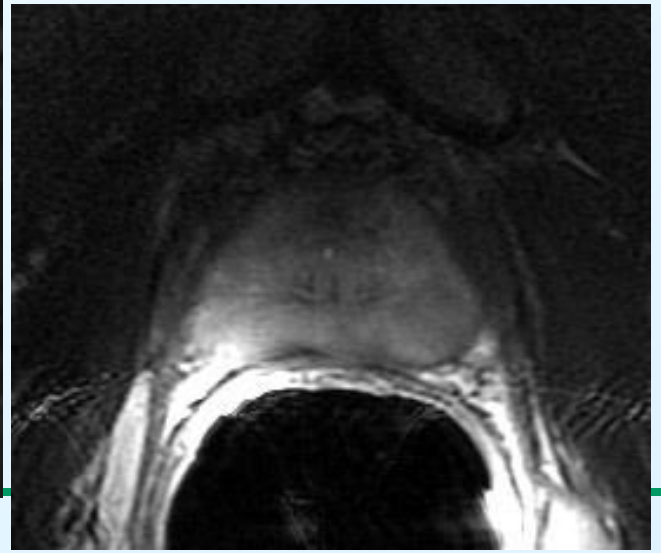
Post EBRT

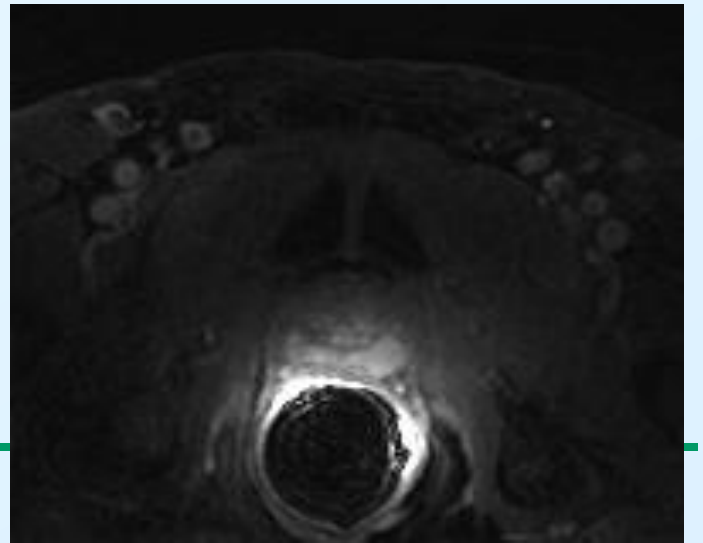




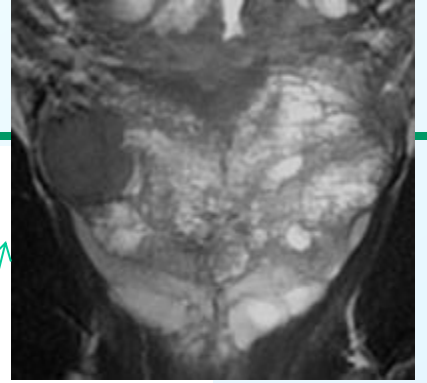
Abnormal restricted diffusion on left side & abnormal DCE







Conclusion



- Clinical drivers
  - Detection/Staging
  - Focal, sub total treatments require high quality accurate imaging with index lesion defined
  - Surveillance imaging
- State of the art:
  - MRI multiparametric with ecoil at 3T
    - Best prostate imaging study available in 2009
- MR Image guided interventions
  - Biopsy, Treatment and f/u