

Imaging in Gynecological Cancers

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Appropriateness..... CT/MRI



...evidence of increased performance with an impact on clinical practice and patient outcome even in the absence of RCT and on the basis of studies assessing diagnostic accuracy with therapeutic impact in the domains:

- ✓ *Diagnosis and staging*
- ✓ *Treatment planning & delivery*
- ✓ *Response assessment*



Appropriateness..... CT/MRI



Diagnosis & Staging

Tumor Site	<u>Imaging Modalities</u>	
	CT Scan	MRI
Rectum	Appropriate	Potentially Appropriate
Anal Canal	Appropriate	Appropriate
Bladder	Appropriate	Potentially Appropriate
Prostate	Appropriate	Potentially Appropriate
Cervix	Appropriate	Appropriate
Endometrium	Appropriate	Potentially Appropriate



Appropriateness..... CT/MRI



Simulation & Planning

Tumor Site	<u>Imaging Modalities</u>	
	CT Scan	MRI
Rectum	Appropriate	Potentially Appropriate
Anal Canal	Appropriate	Potentially Appropriate
Bladder	Inappropriate	Inappropriate
Prostate	Potentially Appropriate	Inappropriate
Cervix	Appropriate	Potentially Appropriate
Endometrium	Potentially Appropriate	Inappropriate



Appropriateness..... CT/MRI



Localization & Delivery

Tumor Site	<u>Imaging Modalities</u>	
	Orthogonal Imaging	Volumetric Imaging
Rectum	Appropriate	Appropriate
Anal Canal	Appropriate	Appropriate
Bladder	Appropriate	Appropriate
Prostate	Appropriate	Appropriate
Cervix	Appropriate	Appropriate
Endometrium	Appropriate	Appropriate



Appropriateness..... CT/MRI



Response Assessment

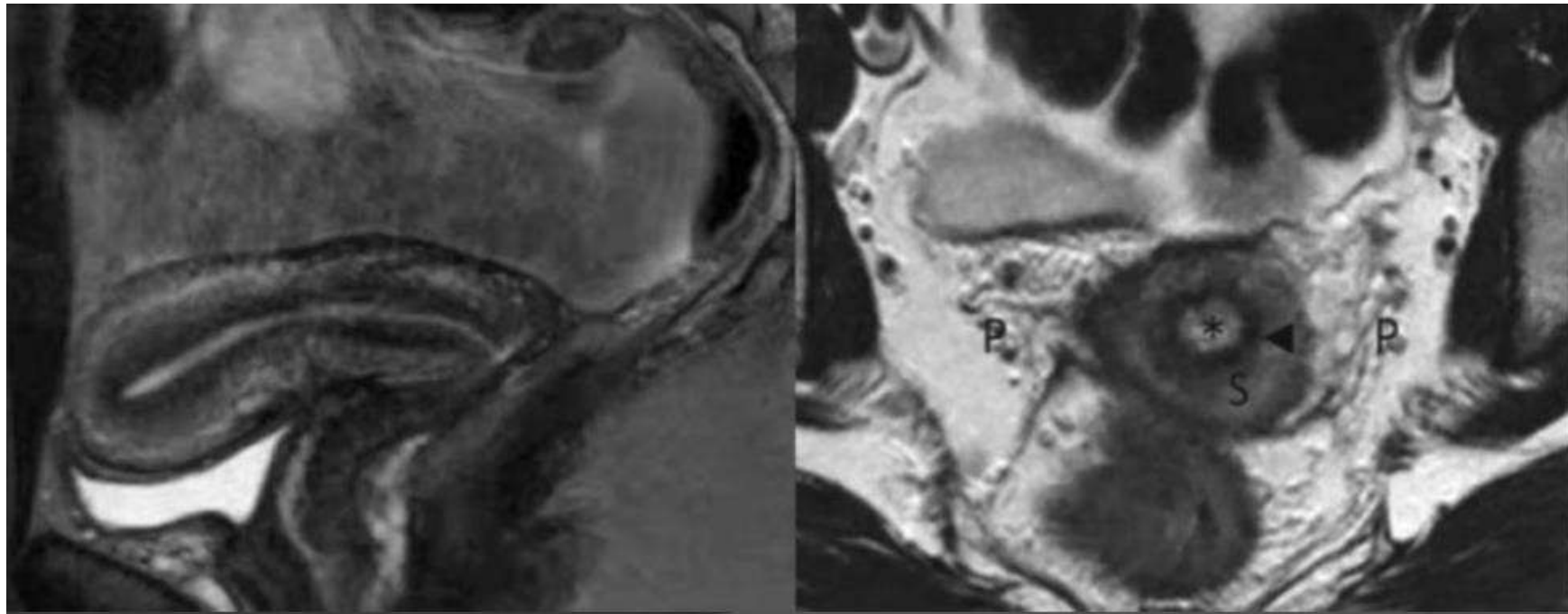
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Prostate	Inappropriate	Inappropriate
Cervix	Appropriate	Appropriate
Endometrium	Inappropriate	Appropriate



NORMAL CERVIX ZONES MRI



The major zones are very well depicted on T2W images. High signal intensity endocervical canal, intermediate signal intensity plicae, low signal intensity fibrous stroma, and intermediate signal intensity outer smooth muscle



Imaging Protocol.....



-
- ✓ Preoperative MR imaging criteria were not included in the FIGO staging system because cervical carcinoma is most prevalent in developing countries, where imaging resources are limited.
 - ✓ MR imaging is highly sensitive and specific and, when available, is recommended as an adjunct to clinical examination
 - ✓ Patient should be fasting 4 to 6 hrs before imaging to minimize motion artifacts from intestinal peristalsis
 - ✓ The use of ante-peristaltic agent such as glucagon/buscopan may be used.
 - ✓ Voiding within 30 minutes before scanning is advised to minimize anatomic ghosting artifacts related to bladder peristalsis and patient movement caused by discomfort.
 - ✓ Compression band may be applied to decrease artifacts related to bowel motion, abdominal wall motion and respiratory artifacts



MR Imaging.....



- T1w : Isointense
- T2w : Hyperintense relative to cervical stroma
- T1w + C : more enhancing than cervical stroma
- DWI : Restricted Diffusion

- ✓ from the kidney to perineum using 256×256 matrix, 32 cm field of view (FOV), This is optimal for evaluation of the pelvis and lower abdomen for lymphadenopathy and hydronephrosis
- ✓ High-resolution T2W images of pelvis are acquired in axial, sagittal, and coronal planes using 512×512 matrix, 24 cm FOV, 4 mm slice thickness, 1 mm interslice gap, for the evaluation of primary tumor and its extension



MR Imaging.....



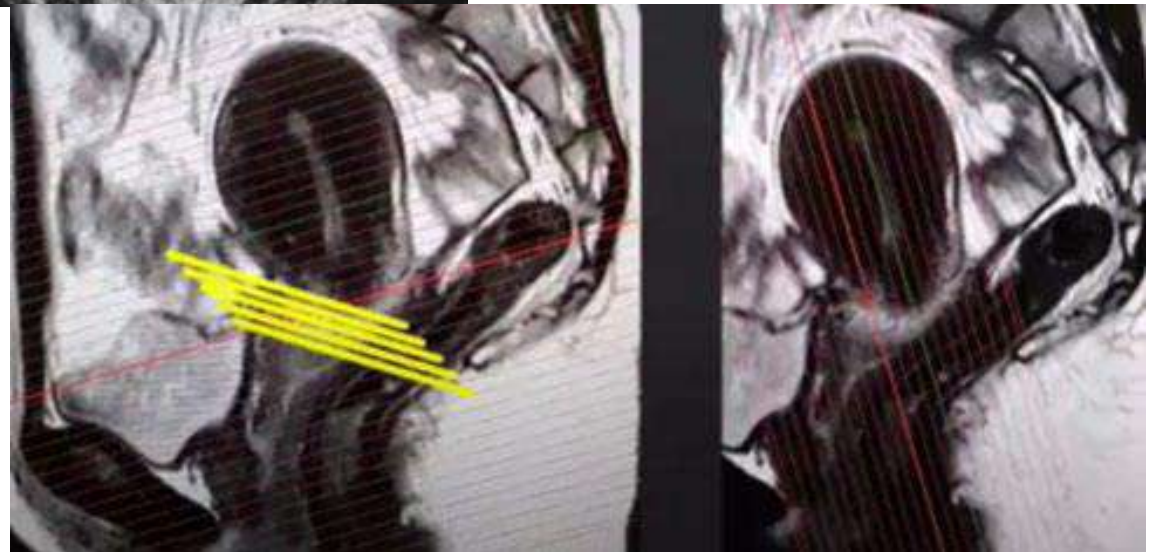
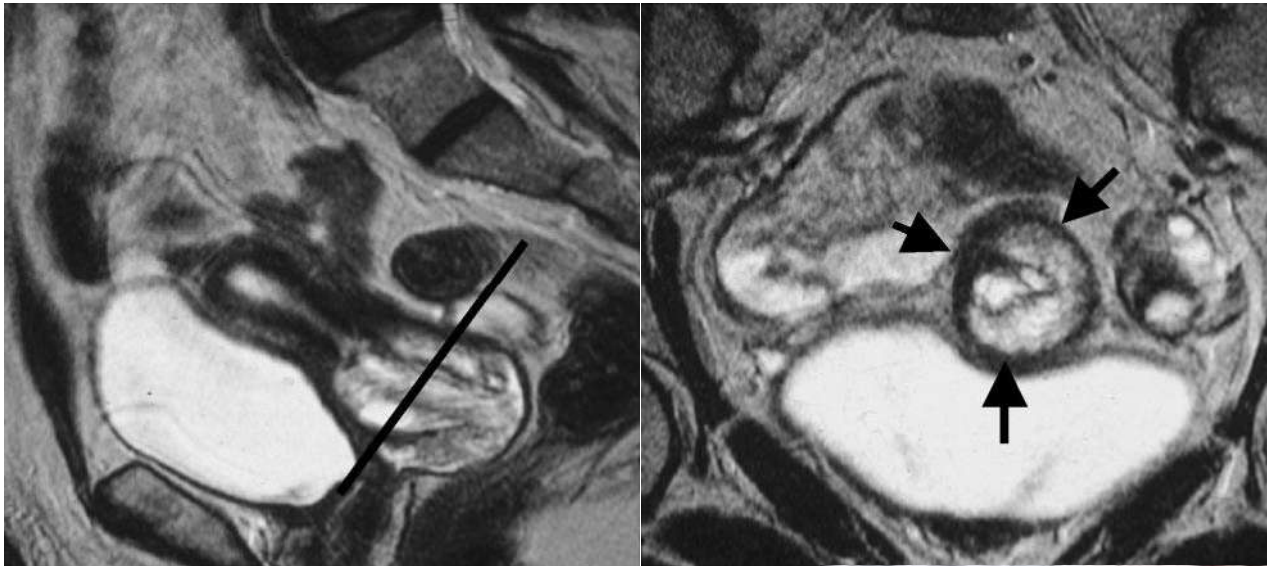
- ✓ The use of intravaginal gel (20 ml of ultrasonographic gel) during the MRI acquisition may be done to distend and fill the cavity with a highly hyperintense material
- ✓ On T2-weighted sequences it improves the tumor and the vaginal wall contrast. This procedure helps in the evaluation of the vaginal invasion



MR Imaging.....



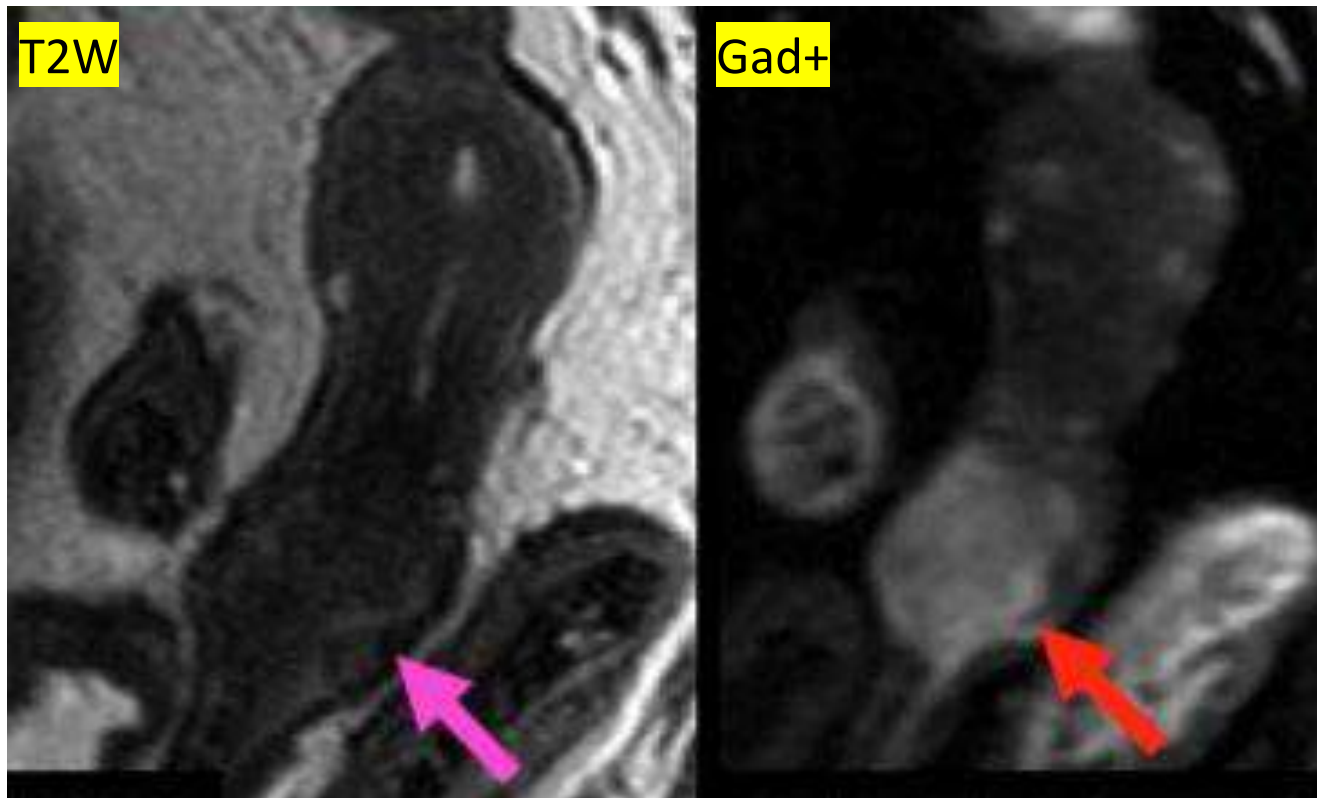
Oblique axial T2W images are planned perpendicular to the long axis of cervix to obtain a true axial representation of cervix





MR Imaging.....

- ✓ Post contrast imaging may not be used routinely because of :
 1. Variable enhancement of tumor and 2. May overestimate stromal & parametrial invasion
- ✓ However dynamic multi-phase contrast images obtained after 30 & 60 seconds are helpful for :
 1. Smaller cervical tumors not clearly visible on T2WI and 2. Recurrent lesions



FIGO.....



The prior 2014 FIGO staging system was revised to incorporate imaging and pathological findings into the new staging system

Three subgroups for Stage IB disease
Incorporation of lymph node (LN) status into stage III disease

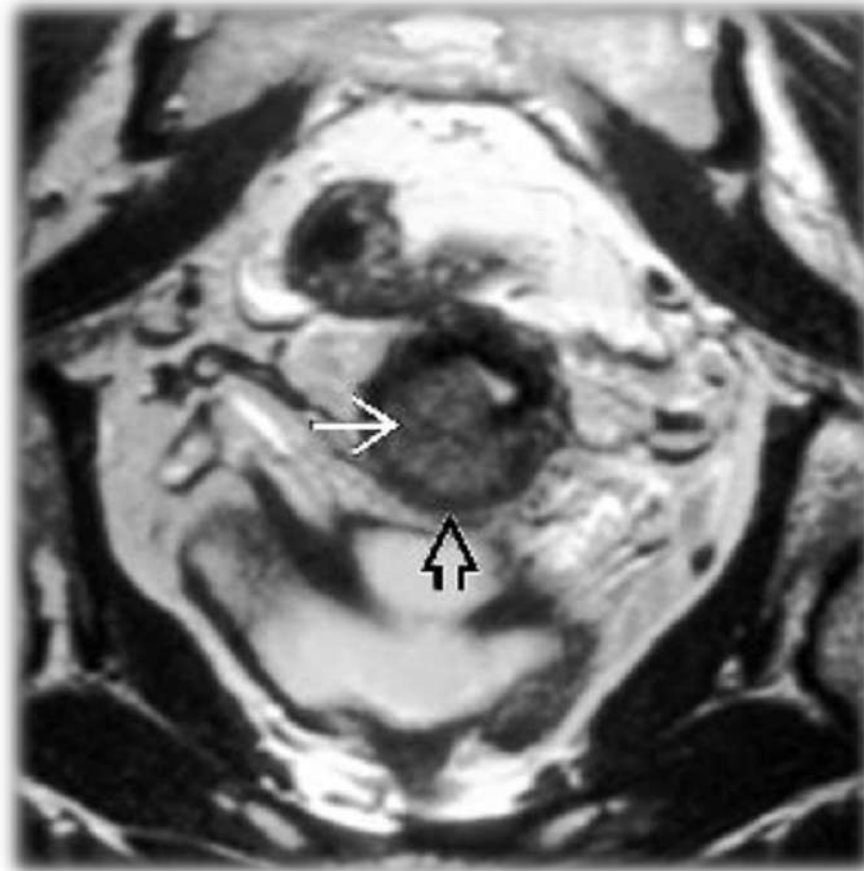
For cancer to be seen on MRI, must be at least stage 1B or above



Stage I – Aim of Imaging



- See whether the cancer is actually microscopic (< 5 mm)
- Assess/confirm the maximum depth of invasion viz. 5mm/2cm/4cm
- The presence of the hypointense ring of normal cervical stroma of at least 3-mm thick has a specificity of almost 99% in excluding parametrial invasion



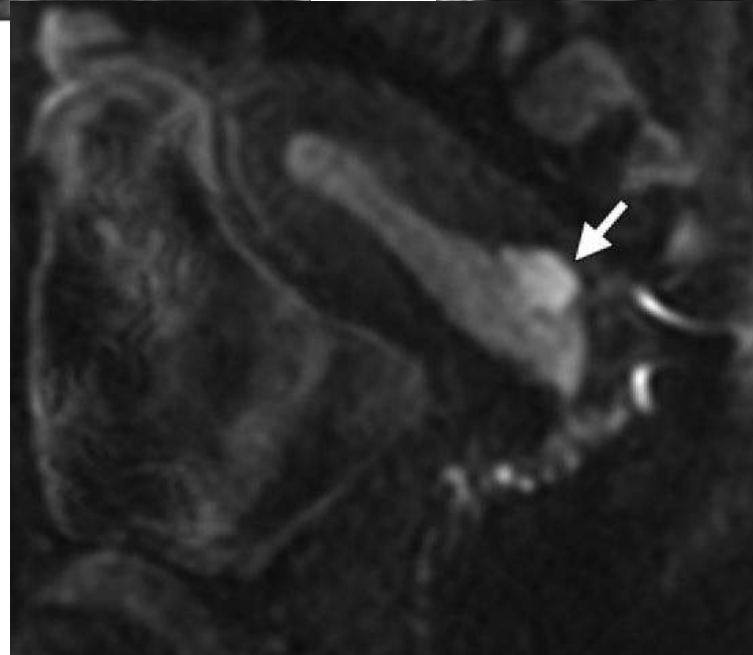
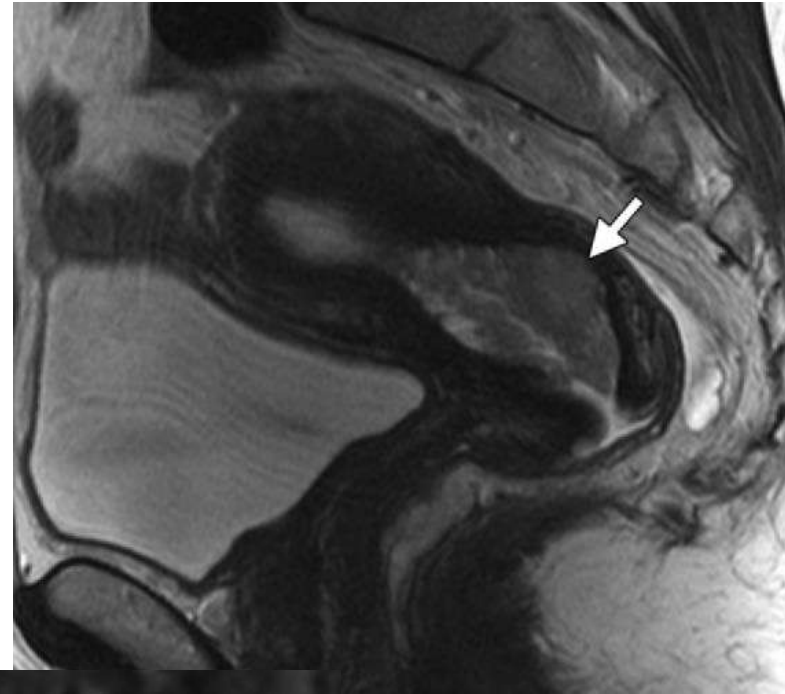
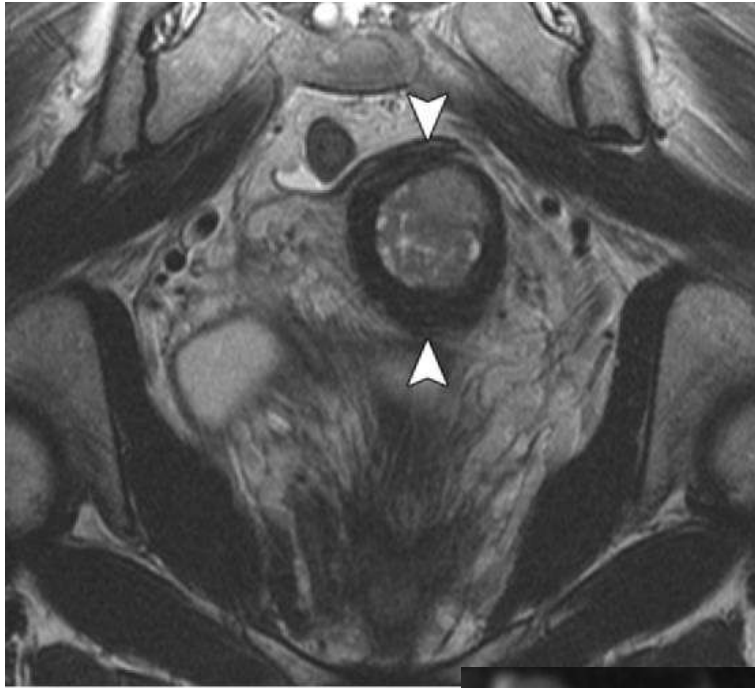
Ia.....



?



Ib.....



Stage I – Why Imaging Must?



• **Clinical** examination allows the tumor size to be estimated on the **axial plane only**.

• On MRI the **craniocaudal dimension** has been found to have a more significant prognostic factor than the axial dimension as a result of the stronger association with endometrium and nodal involvement.

• MRI is highly accurate in determining tumor size and has been found to be within 5 mm of surgical size in 90% of case



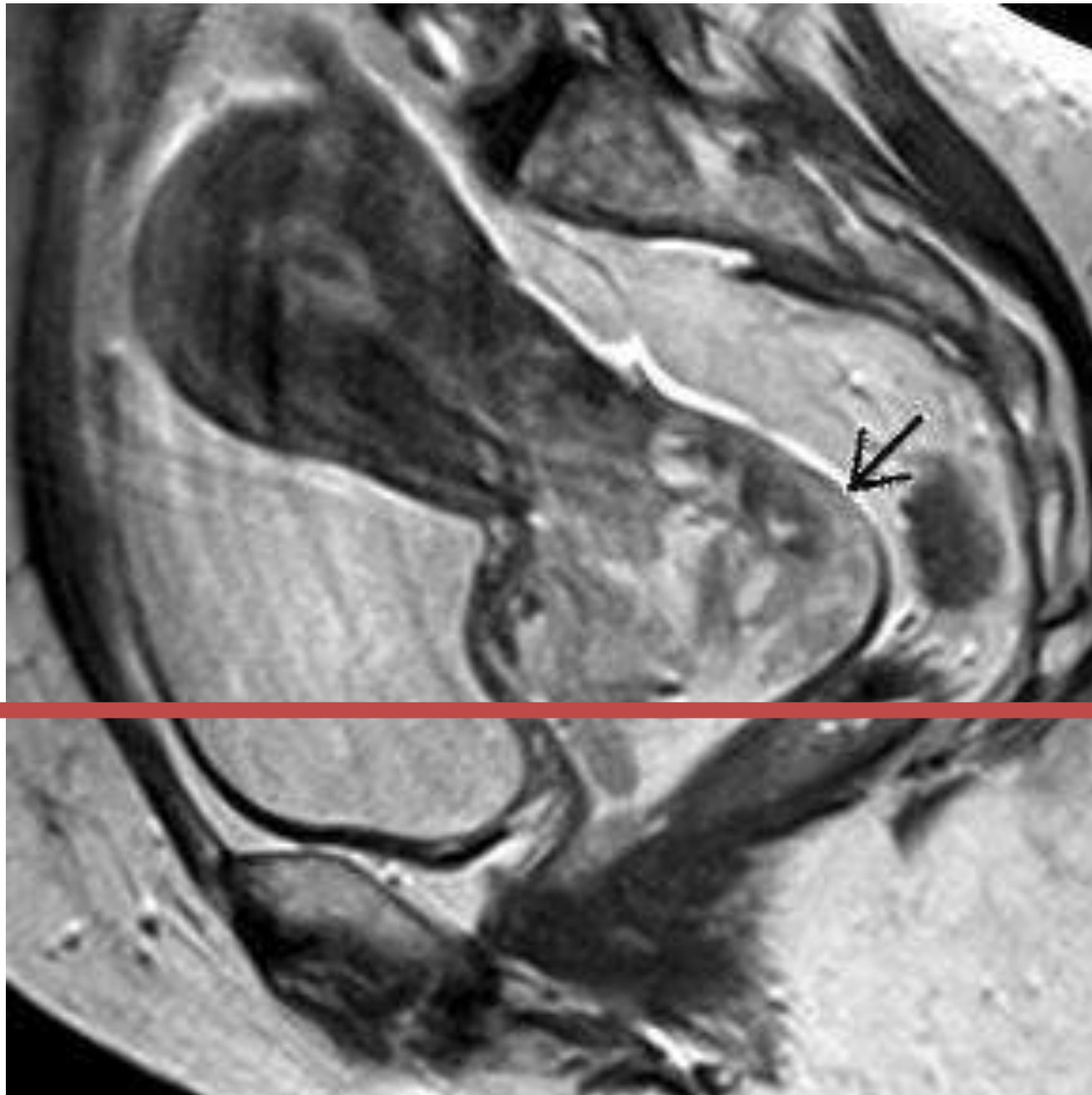
Stage II – Aim of Imaging



- Assess the status of Vagina – **hence with Gel**
- Assess the maximum depth of invasion viz. Parametra
- The presence of the hypointense ring of normal cervical stroma of at least 3-mm thick has a specificity of almost 99% in excluding parametrial invasion



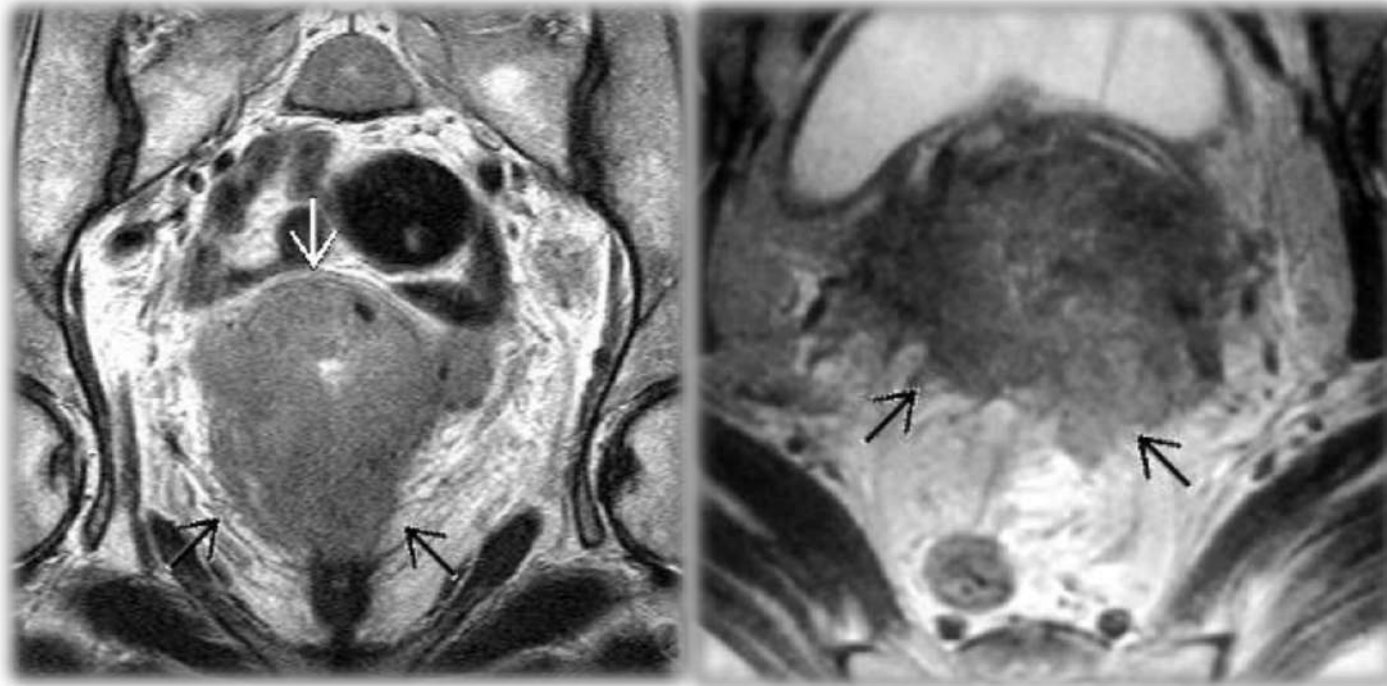
Ila.....



IIb.....



-
- In the published literature, accuracy of MRI in detecting parametrial invasion is in the range of 87% to 96%
 - Axial and coronal T2-weighted images are generally sufficient for identifying parametrial invasion
 - The uniformly T2 hypointense cervical stroma is replaced by the cervical tumor, and there is tumor extension beyond the cervical contour



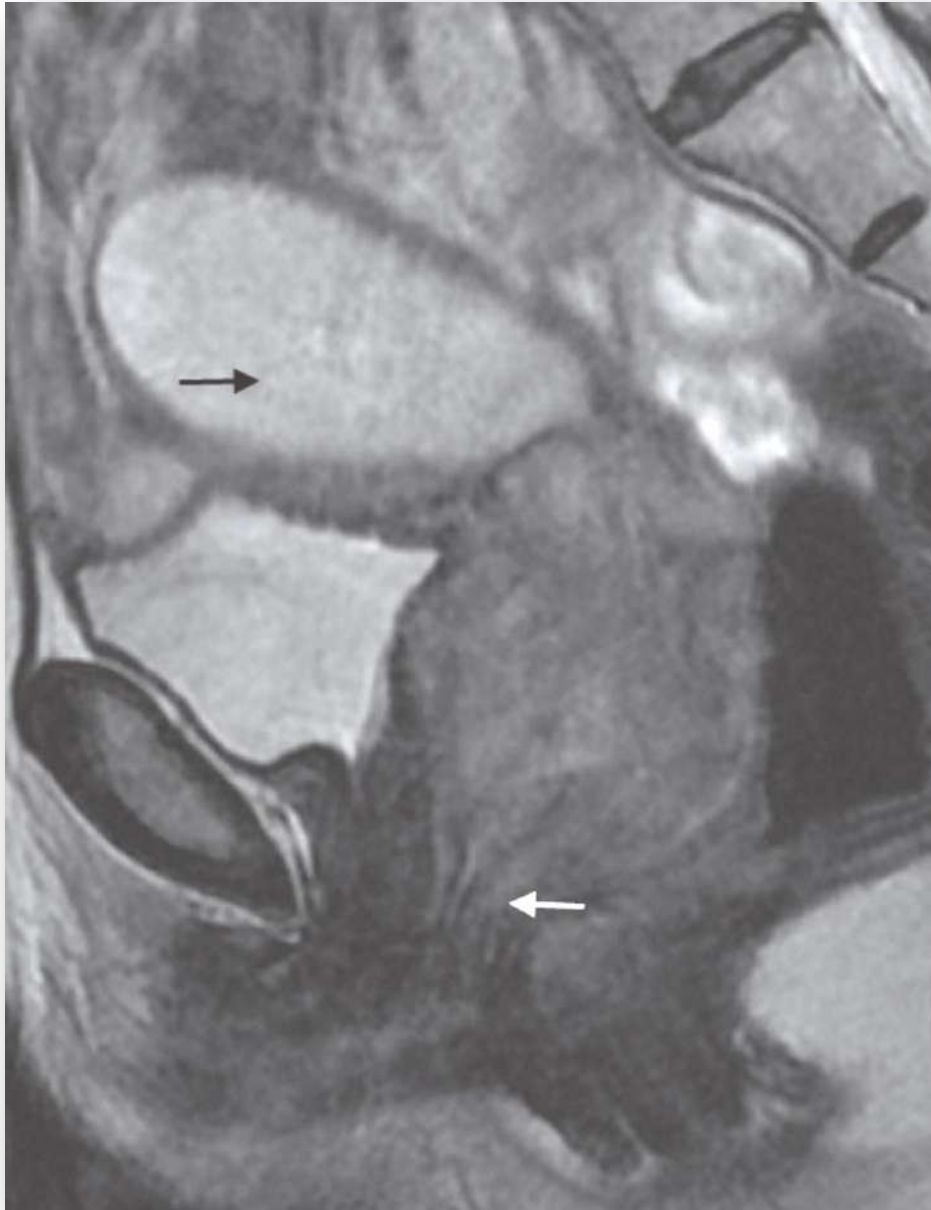
Stage III – Aim of Imaging...



- Assess the status of Vagina – **hence with Gel**
- Assess the maximum depth of invasion viz. Parametra – Whether reaching pelvic wall
- Assess the nodes, kidney



IIIa.....



The normal hypointense T2 signal of the vaginal vault at the lower third is disrupted by tumor, and this is best assessed on the sagittal planes



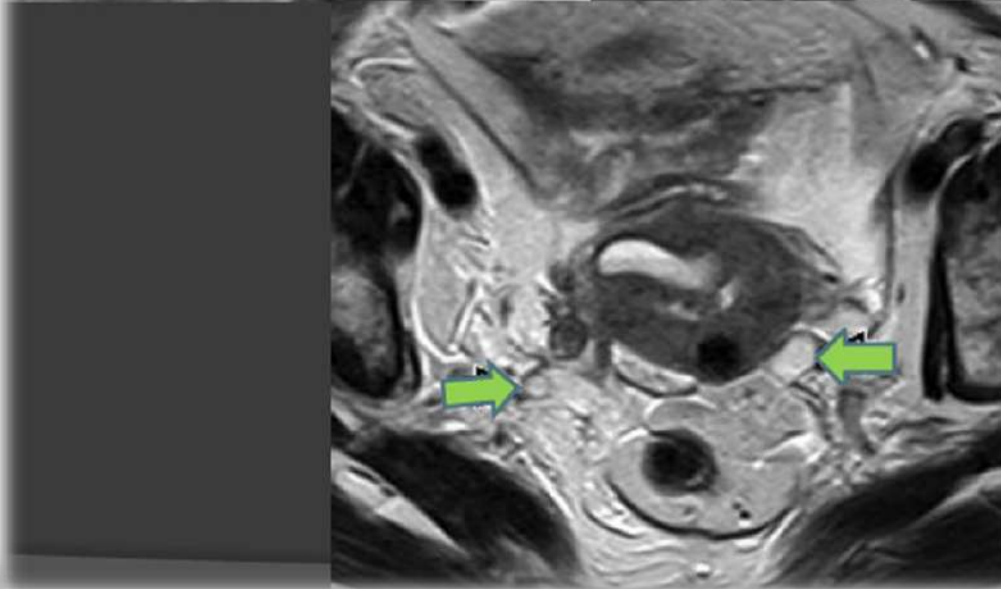
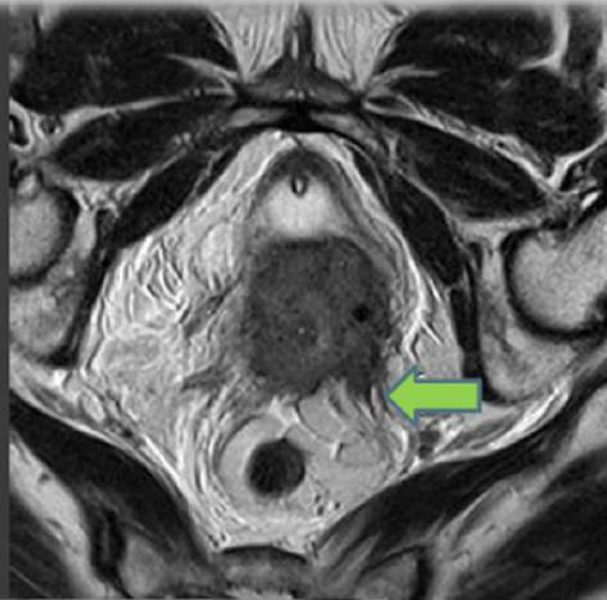
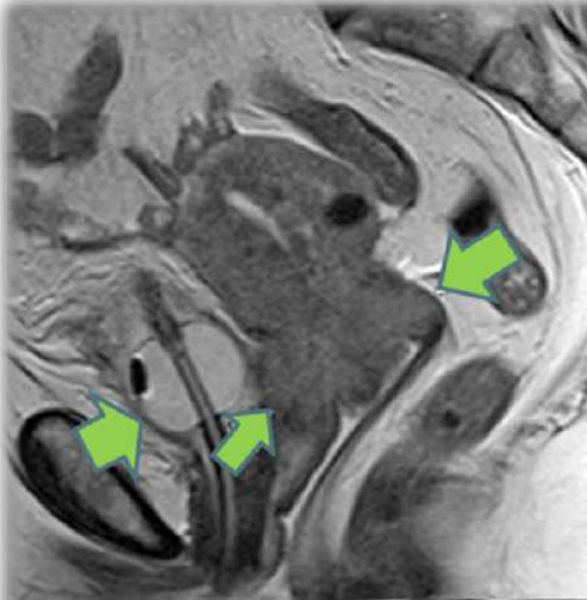
IIIb.....



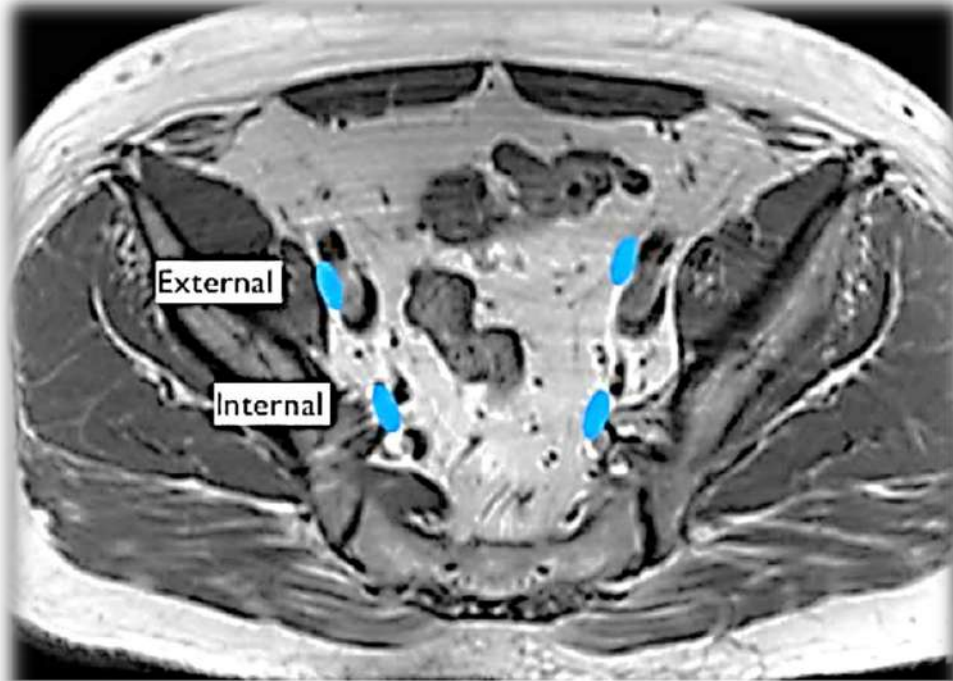
- A large field-of-view T2-weighted or fluid-sensitive sequence of the abdomen and pelvis including the kidneys and ureters in the coronal allows a rapid evaluation of the urinary tract
- Tumor extension to the pelvic sidewall is characterized by the tumor extending to within 3 mm of the obturator internus, levator ani, or piriformis muscles, gross involvement of these muscles or encasement of the iliac vessels



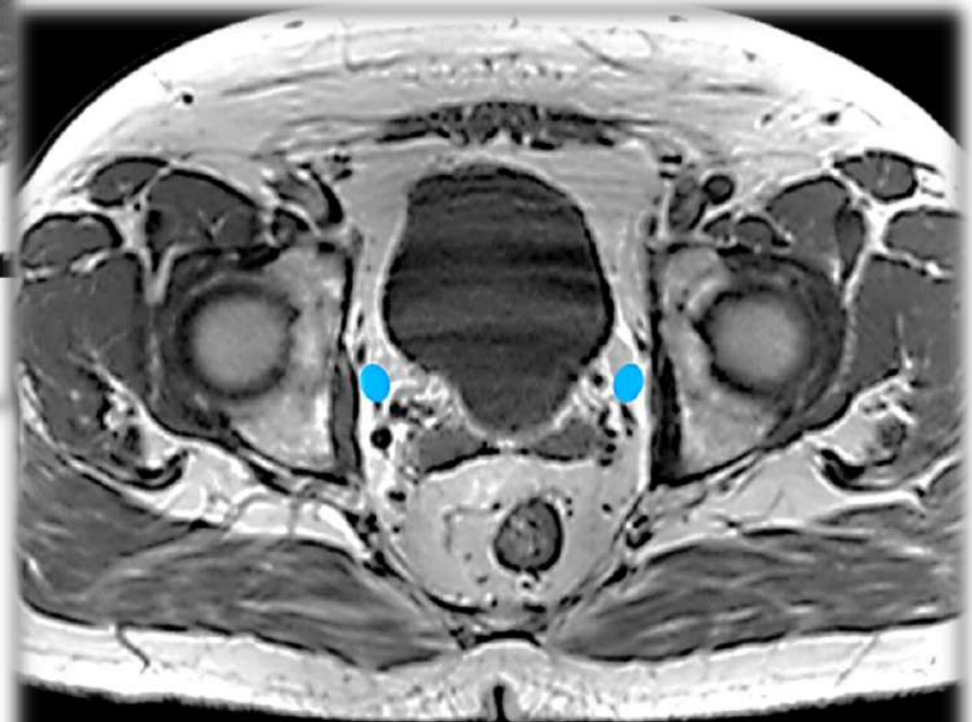
IIIb.....



IIIc.....



External Iliac and Internal Iliac (hypogastric) lymph Nodes



Obturator Lymph Nodes



IVa.....

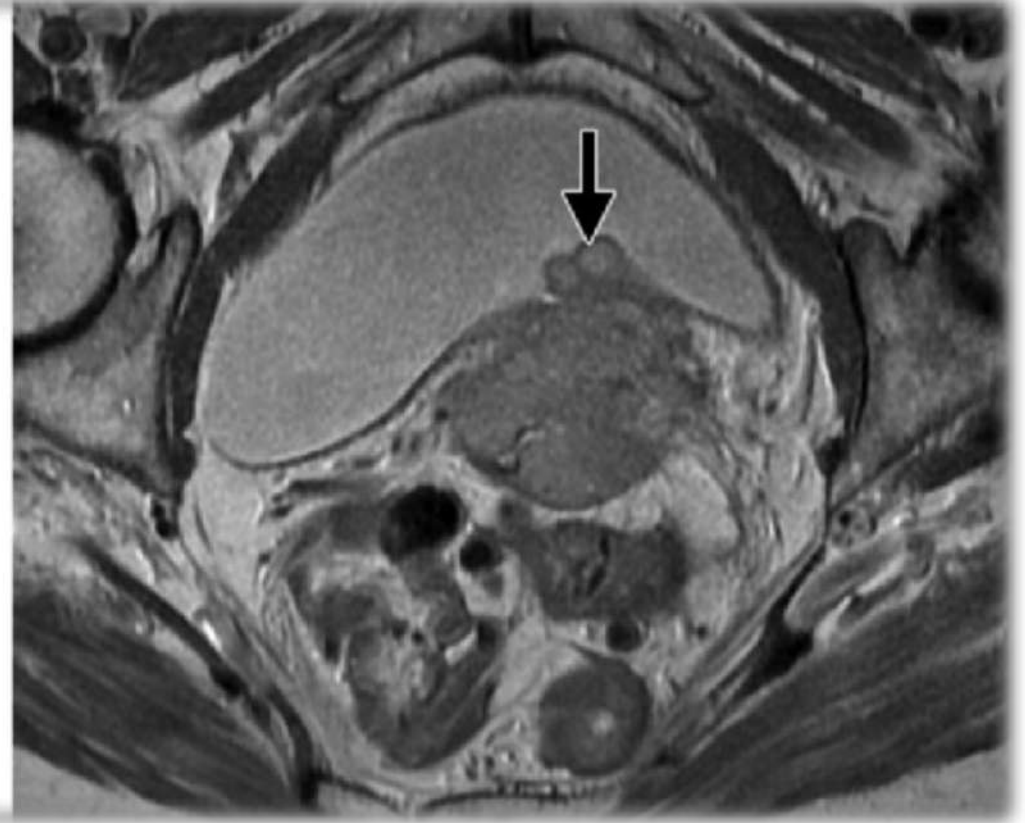
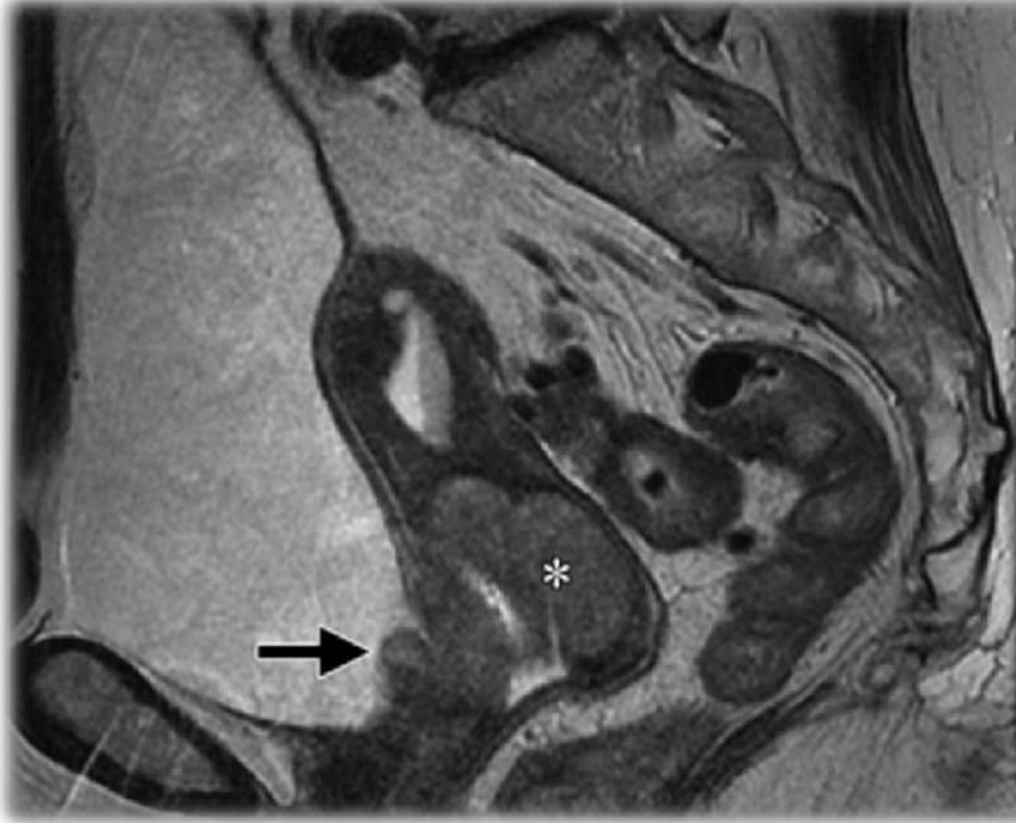


The normal hypointense wall of the urinary bladder and rectum are disrupted on T2-weighted images

There may be nodular wall thickening or frank tumor invasion into the lumen



IVa.....

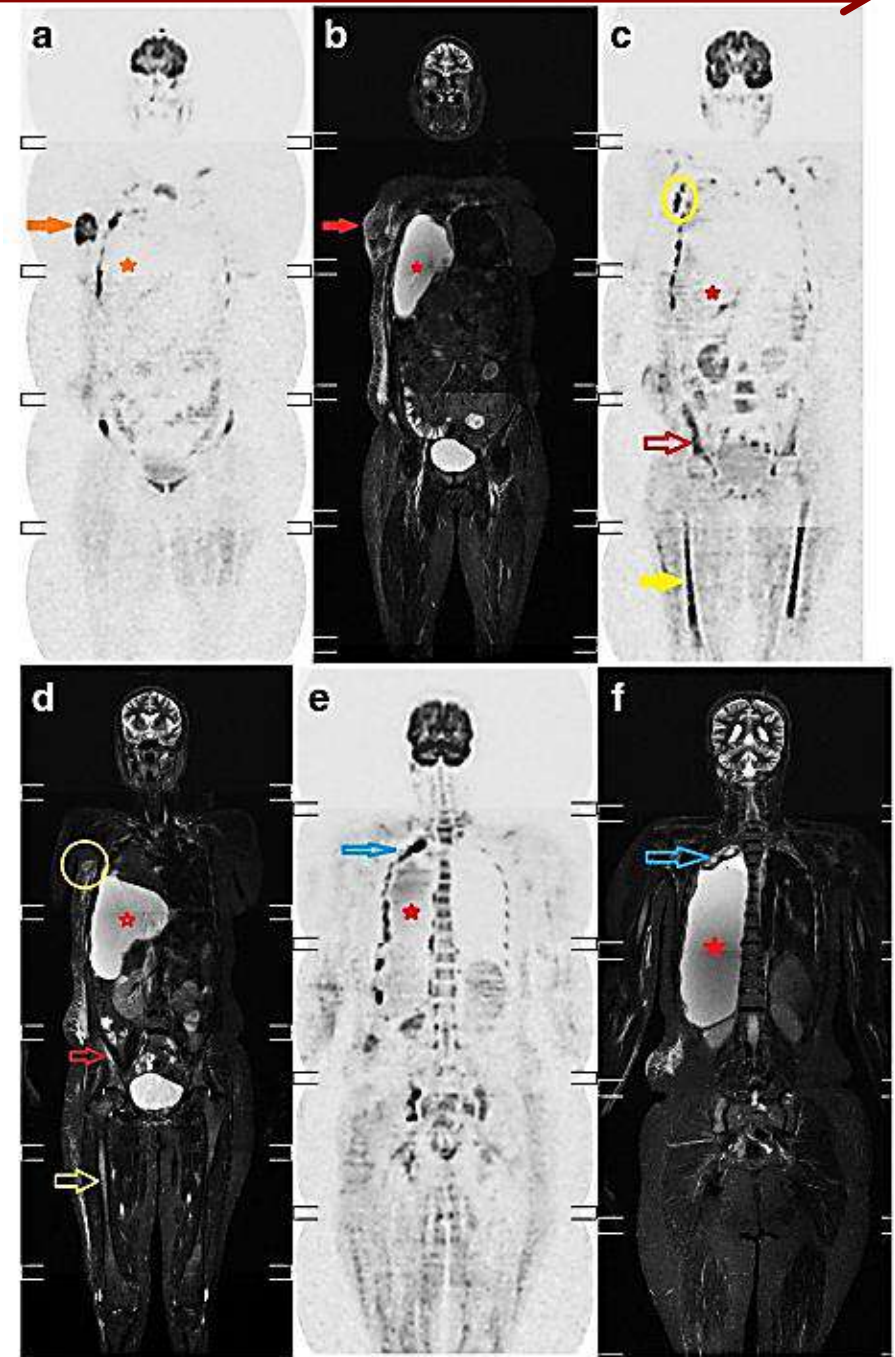


IVb.....



Whole body diffusion-weighted MRI in detection of metastasis and lymphoma: a prospective longitudinal clinical study

EJRNM 2020



L.N.....



LN status and number of LN involved = **Most Important Prognostic Factors.**

5-year survival rates drops from 51 -78 % in Stage IB-IIA disease with LN involvement compared to 88 – 95 % without LN disease

Short axis diameter ≥ 1 cm

Low-moderate sensitivity

Metastases to normal size LN undetected - **Seen on PET CT**

DWI cannot distinguish benign vs malignant LN

PET/CT improves N and M staging and is recommended for Stage IB2 and above disease



Agenda.....



“questions”

which my radiation oncology

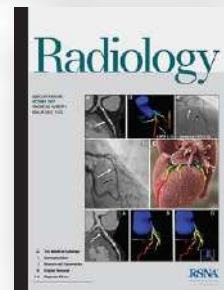
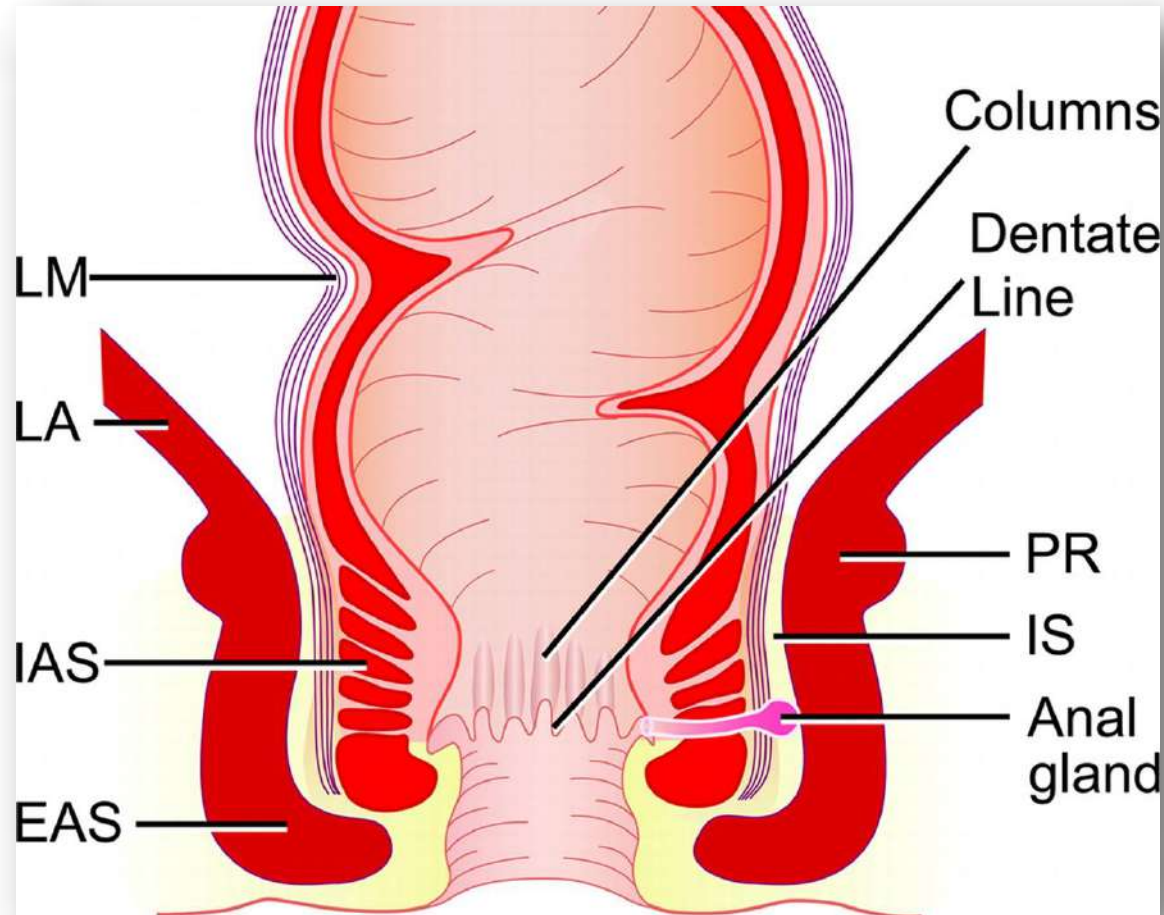
friends asked me

while

planning pelvic irradiation



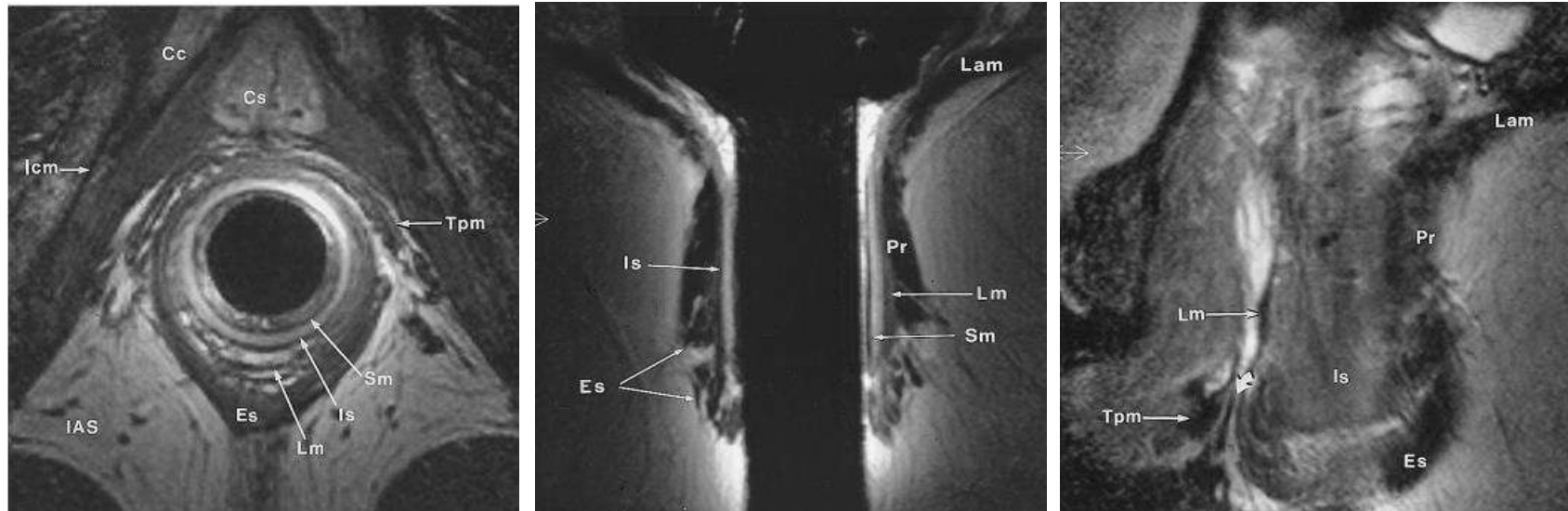
Pelvic floor – Levator ani, puborectalis are they seen ?



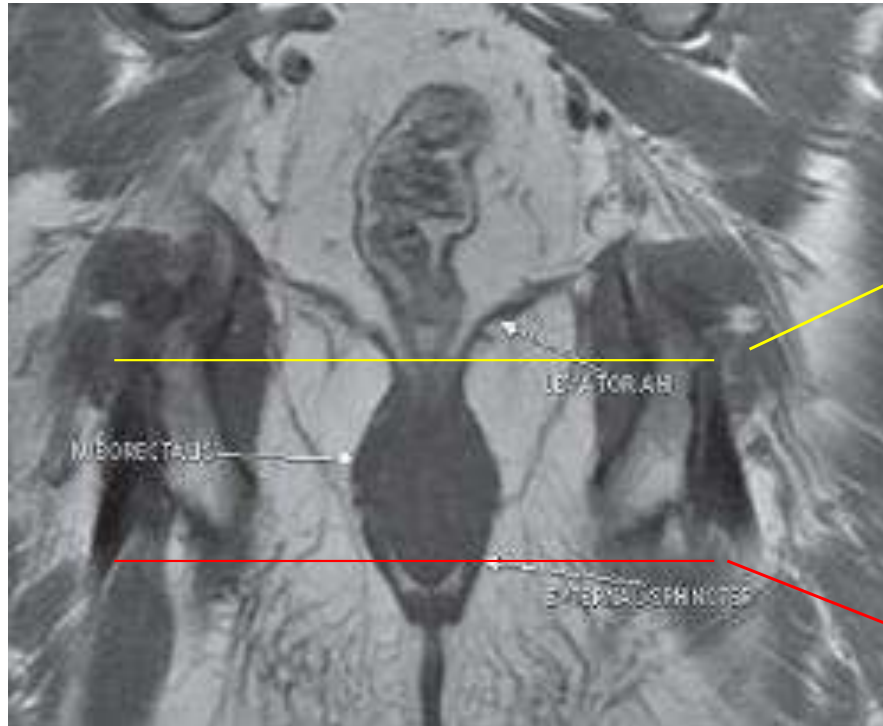
Pelvic floor – Levator ani, puborectalis are they seen ?



High-Spatial-Resolution Endoanal MR Imaging Normal Anal Sphincter Anatomy

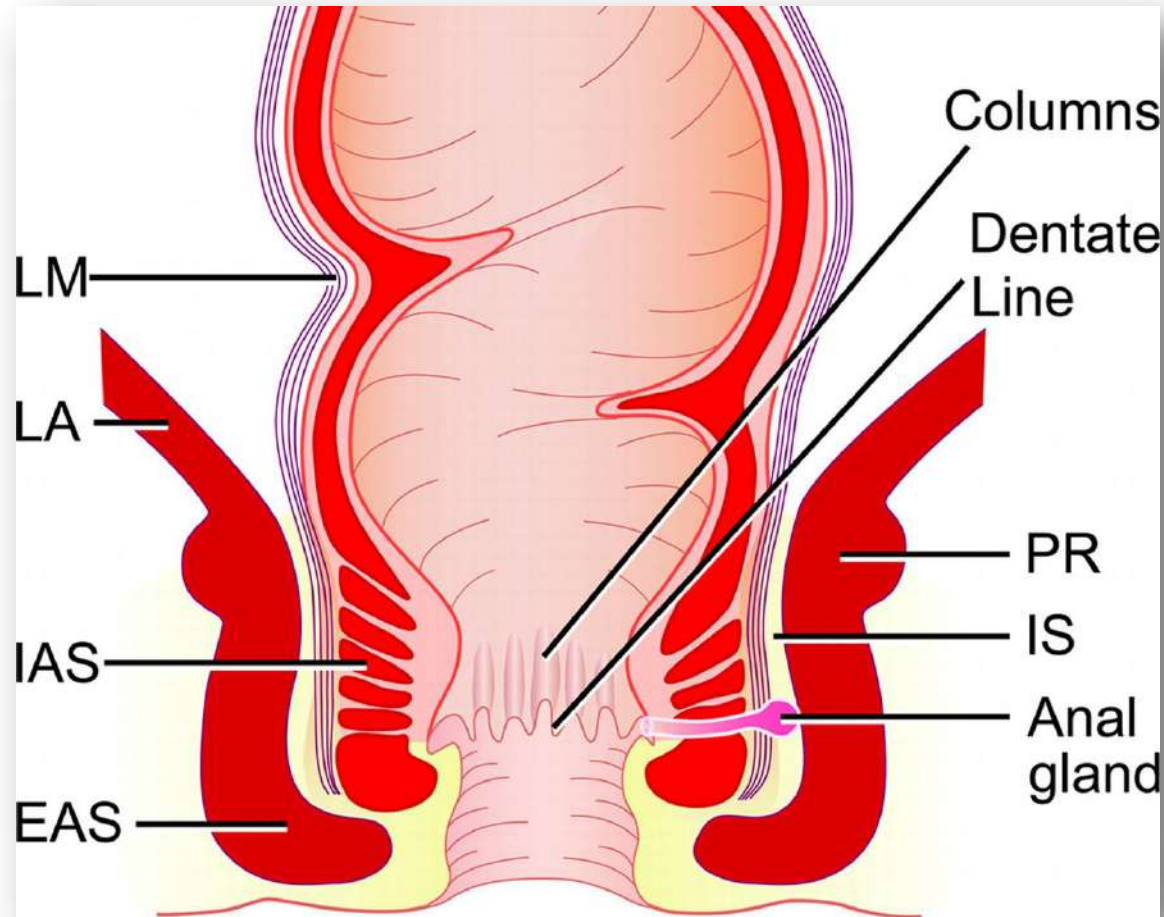


Pelvic floor – Levator ani, puborectalis are they seen ?

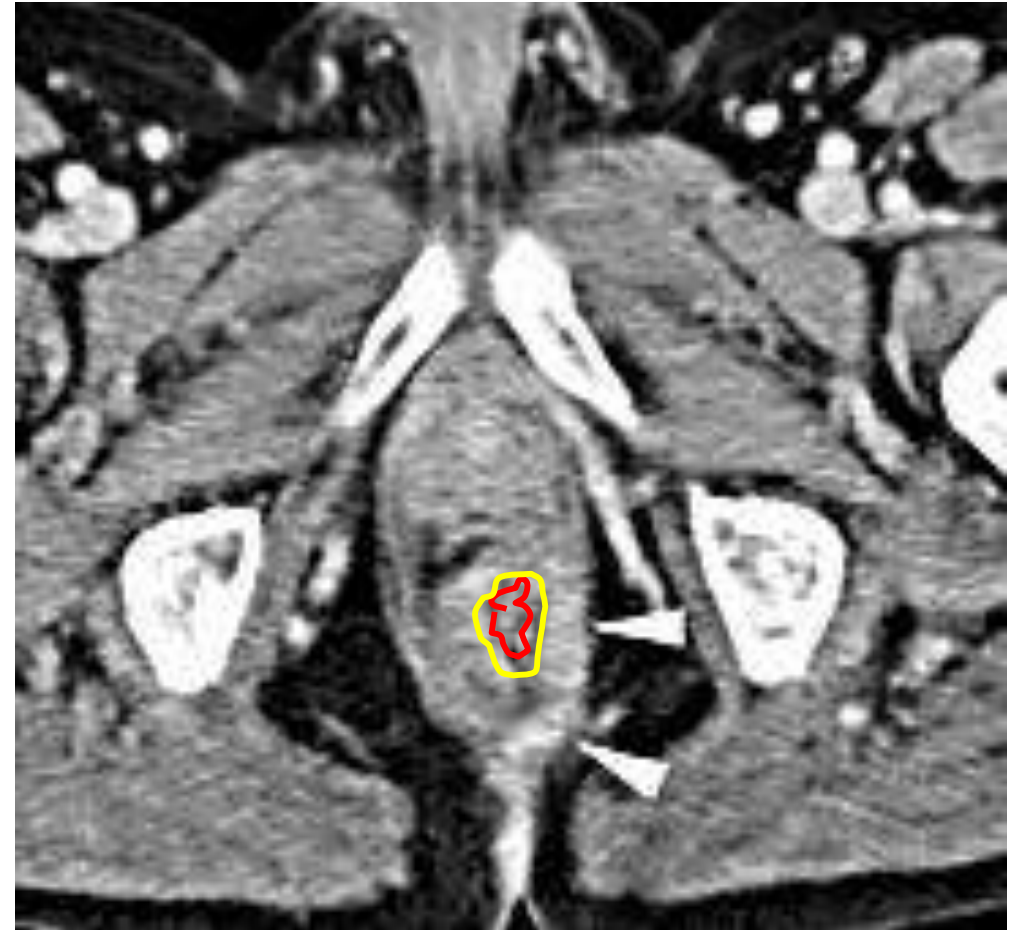




How to define the anal verge ?



How to define the anal verge ?



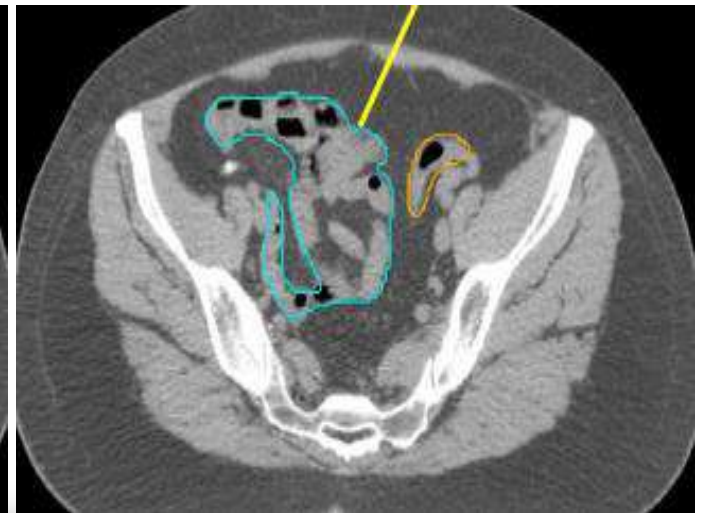
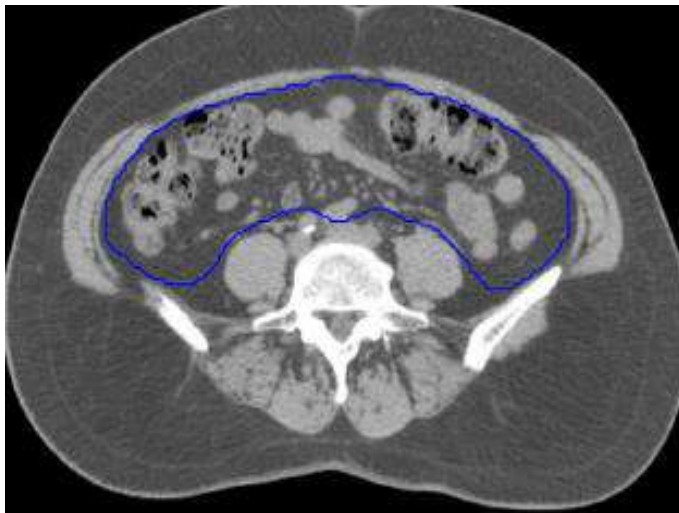


How about the bowel bag ?



Peritoneal space occupied or potentially occupied by bowel

All intestine seen above the rectum, circular or oval , < 15 cm sized, having oral contrast .

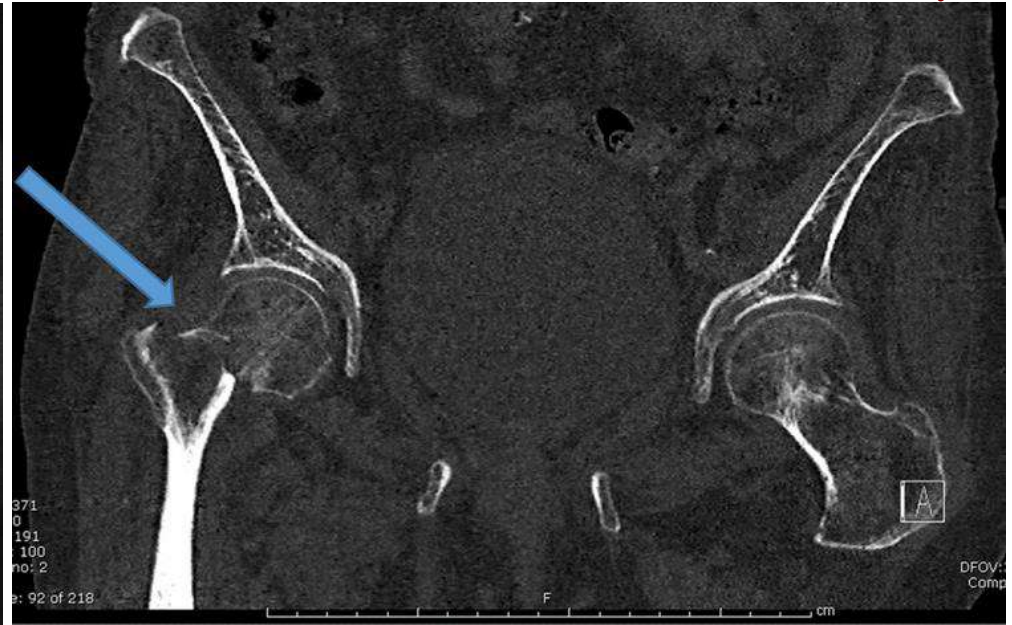
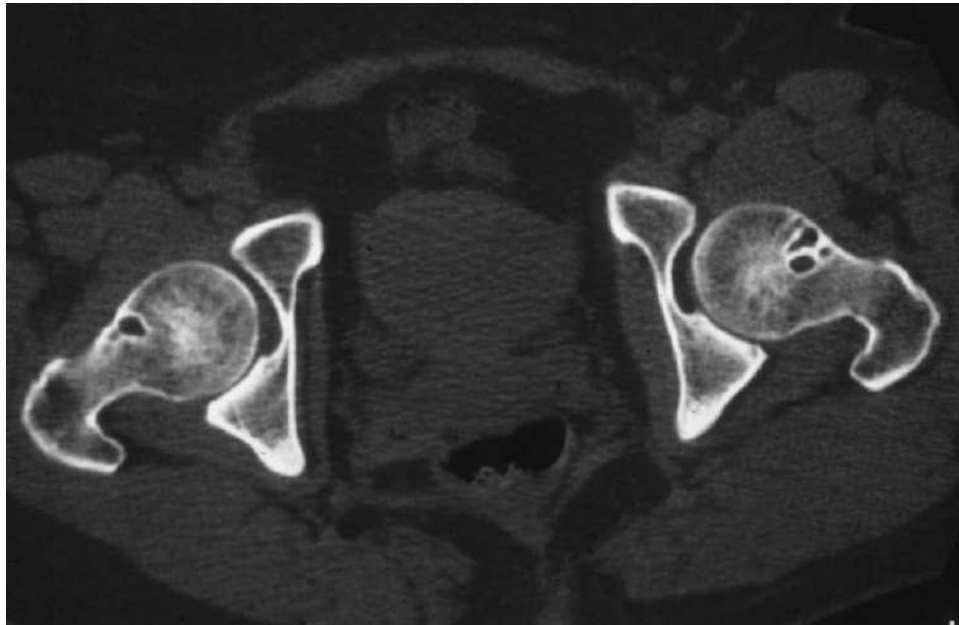


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AMERICAN COLLEGE OF
RADIOLOGY



How to locate the head of femur ?

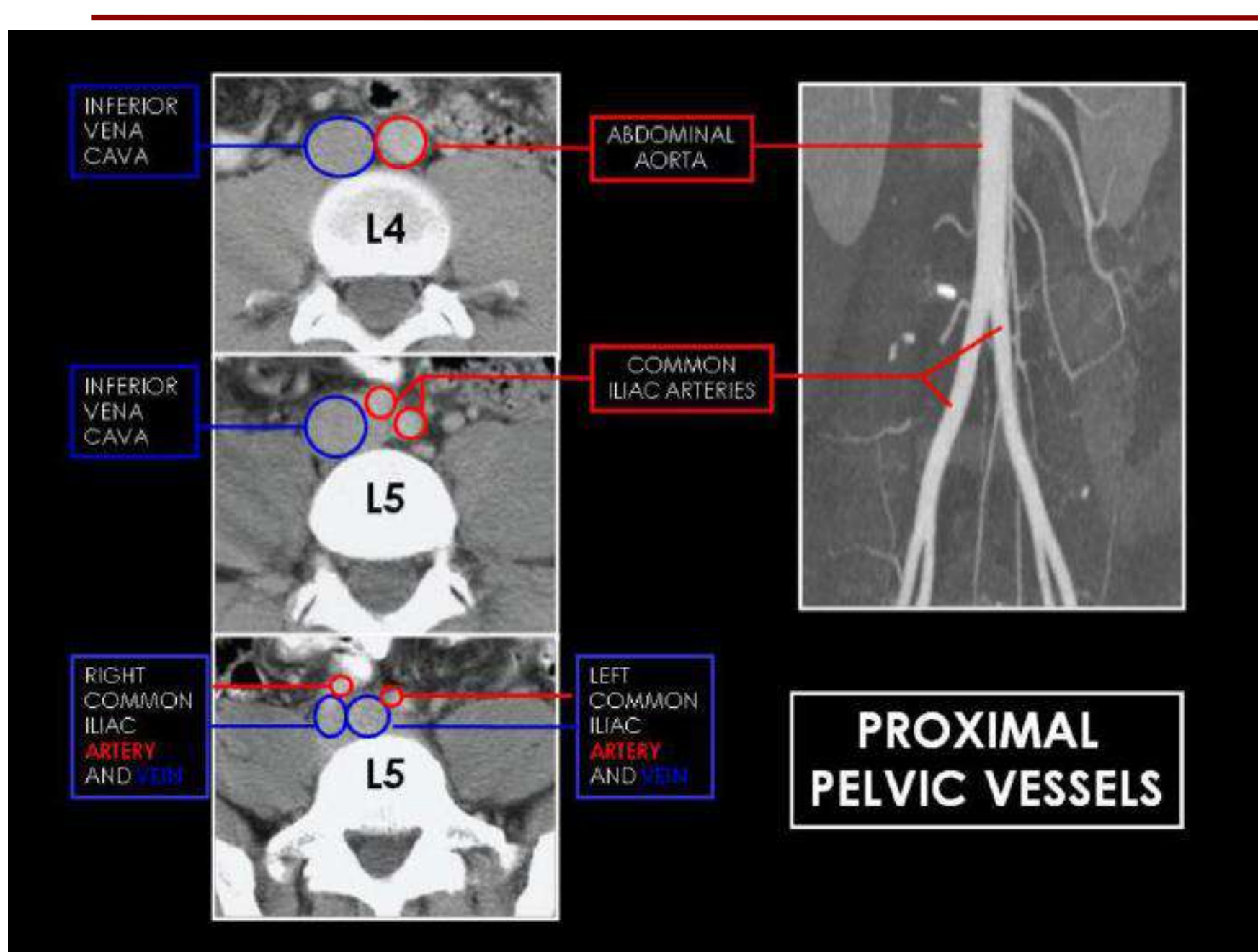


Evaluate with
Multiplanar
Reconstruction

Evaluate in
bone window
W:1800 L:400



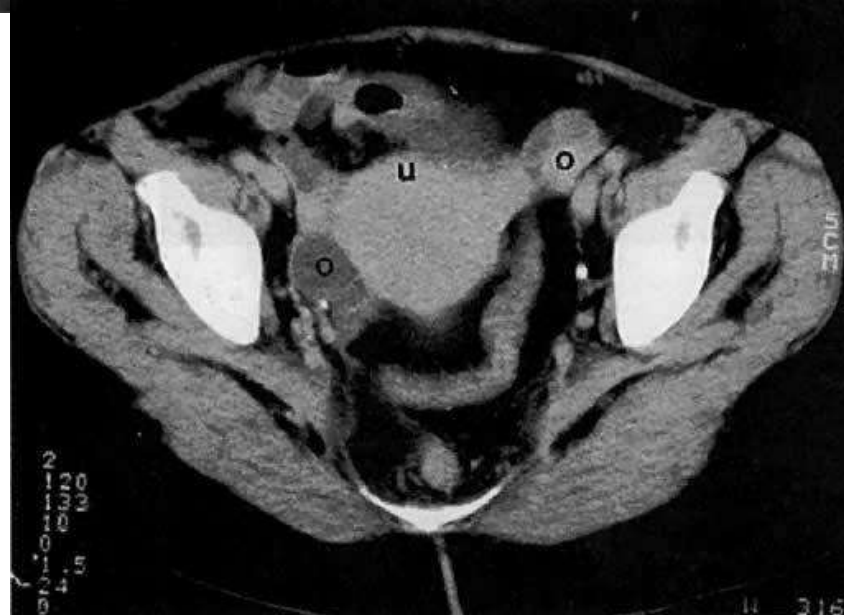
Where is the aortic bifurcation ?



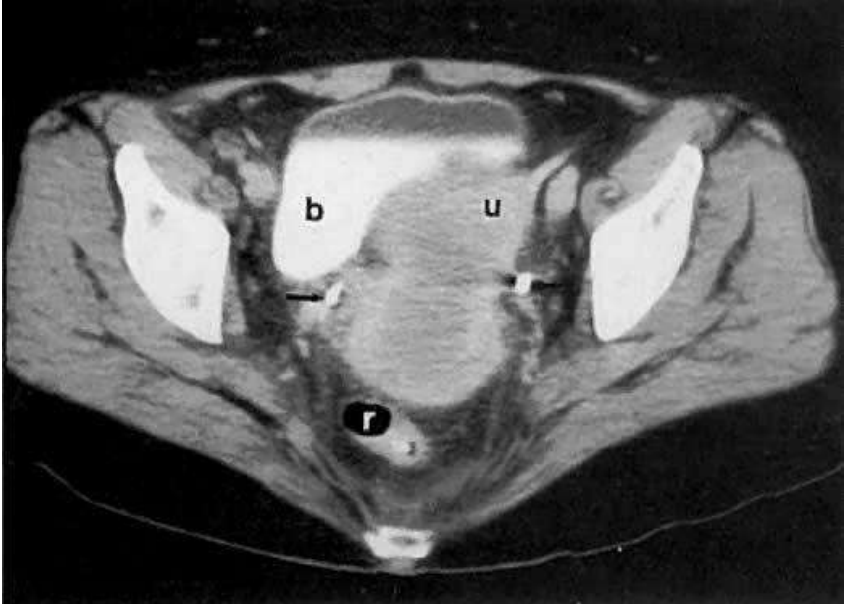
Uterus – Dextro vs Laevo / Ante vs Retro / Anomalous ?



Uterus – Dextro vs Laevo / Ante vs Retro / Anomalous ?



Uterus – Dextro vs Laevo / Ante vs Retro / Anomalous ?



Role of MRI – Beyond yesterday.....?



The value of advanced MRI techniques in the assessment of cervical cancer: a review

- ✓ *Conventional MRI plays a key role in the evaluation of cervical cancer*
- ✓ *DWI improves tumour delineation and detection of nodal metastases in cervical cancer*
- ✓ *Advanced MRI techniques show promise regarding histological grading and subtype differentiation*
- ✓ *Tumour ADC is a potential biomarker for response to treatment*

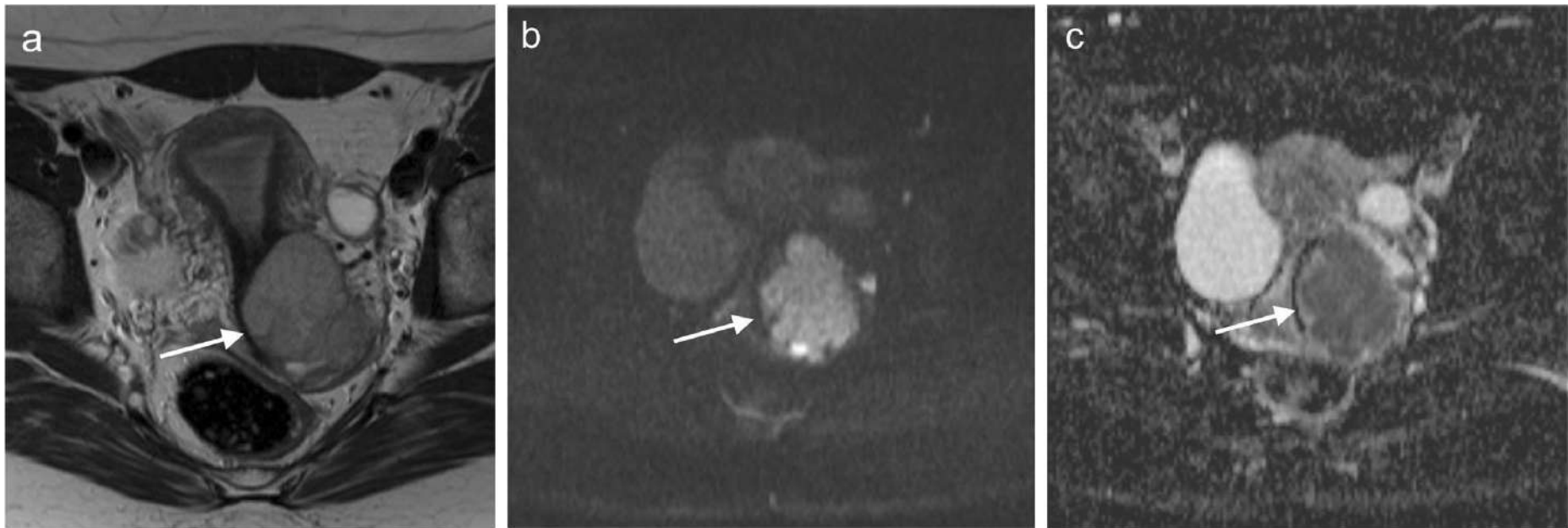




Role of MRI – Beyond yesterday.....?



The value of advanced MRI techniques in the assessment of cervical cancer: a review



Role of MRI – Beyond yesterday.....?



Value of Dynamic Contrast-enhanced and Diffusion-weighted MR Imaging in the Detection of Pathologic Complete Response in Cervical Cancer after Neoadjuvant Therapy: A Retrospective Observational Study¹

Time–signal intensity curve on DCE

ADC values from DWI are associated with completeness of response

These could potentially help oncologists with management decisions

DCE & DWI

could help oncologists accentuate the follow-up for patients with a high risk of local recurrence





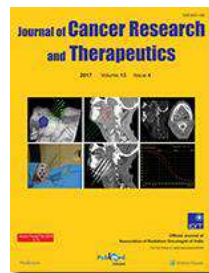
Role of MRI – Beyond yesterday.....?

Evaluation of diffusion-weighted imaging as a predictive marker for tumor response in patients undergoing chemoradiation for postoperative recurrences of cervical cancer

Baseline ADC & focal regions of diffusion restriction predicts partial response with moderate sensitivity & specificity in patients with postoperative recurrences of cervical cancer

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Role of MRI – Beyond yesterday.....?



PET/CT and MRI in Evaluating Cervical Cancer

PET/CT is superior for lymph node (LN) status and metastasis to other imaging modalities.

Emerging functional imaging modality esp. DWI has been showing its superiority in evaluation of cervical carcinoma

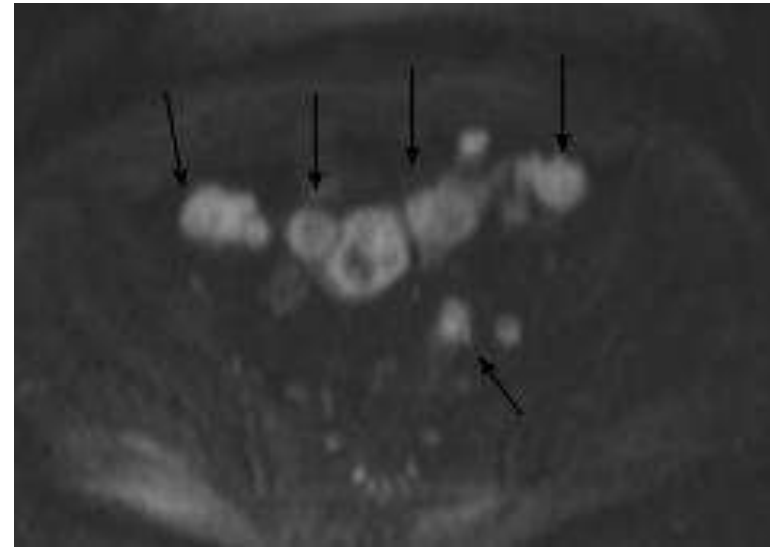


Role of MRI – Beyond yesterday.....?



Diffusion weighted Imaging

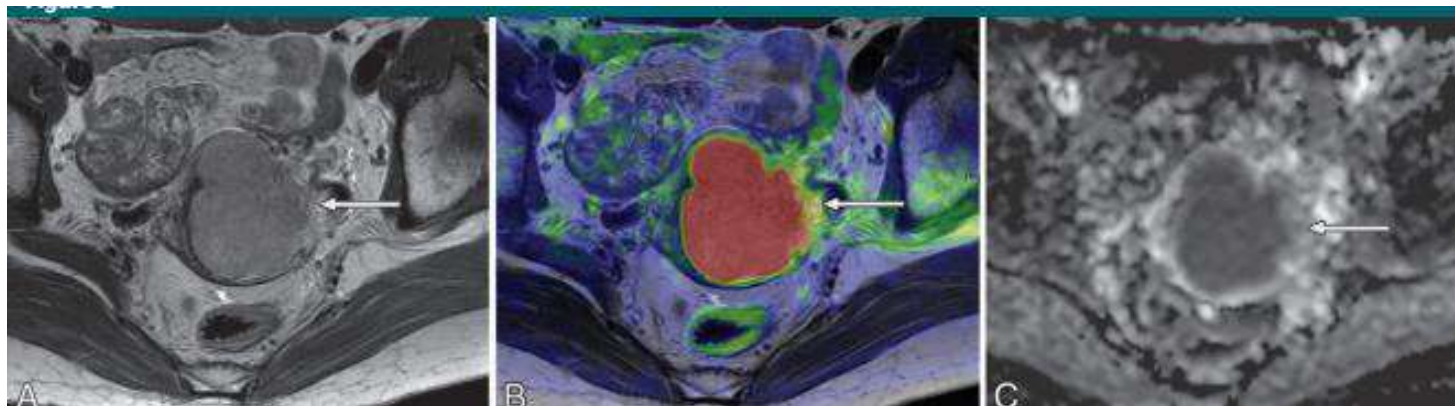
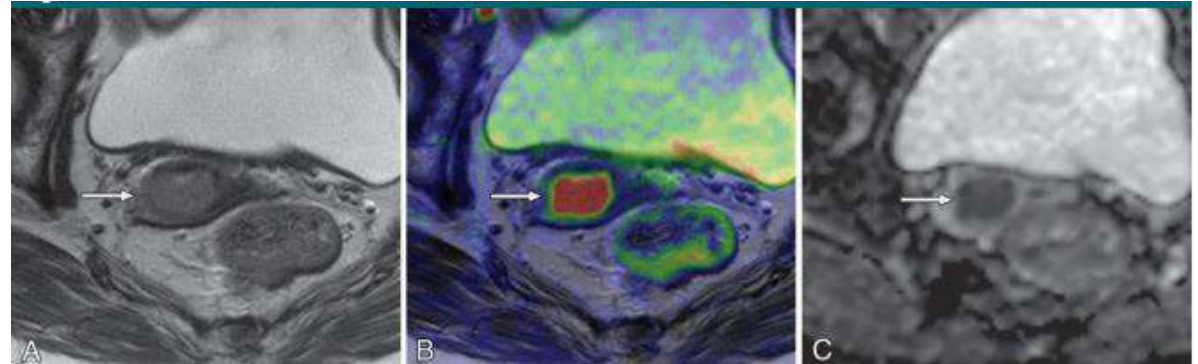
- ✓ *Actual tumor bulk*
- ✓ *Parametrial invasion*
- ✓ *Response assessment*
- ✓ *Lymph Nodes*





Role of MRI – Beyond yesterday.....?

Parametrial Invasion in Cervical Cancer: Fused T2-weighted Imaging and High-*b*-Value Diffusion-weighted Imaging with Background Body Signal Suppression at 3 T¹

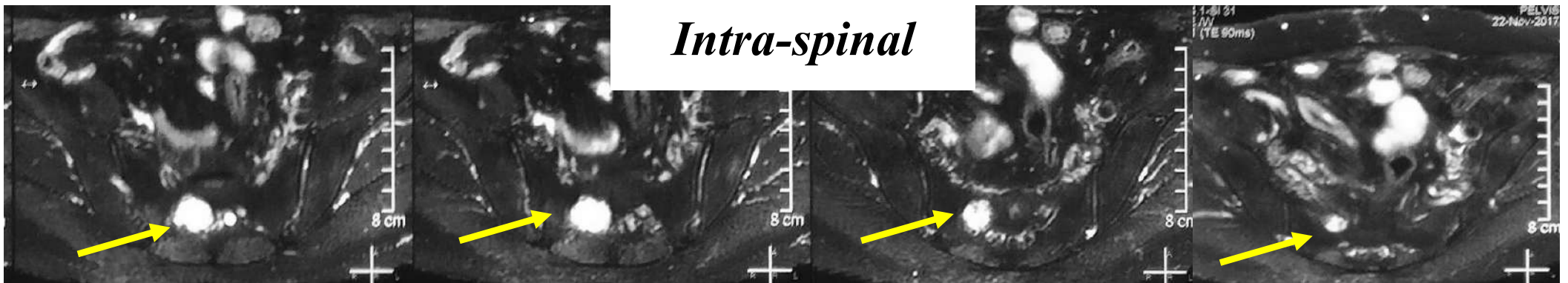
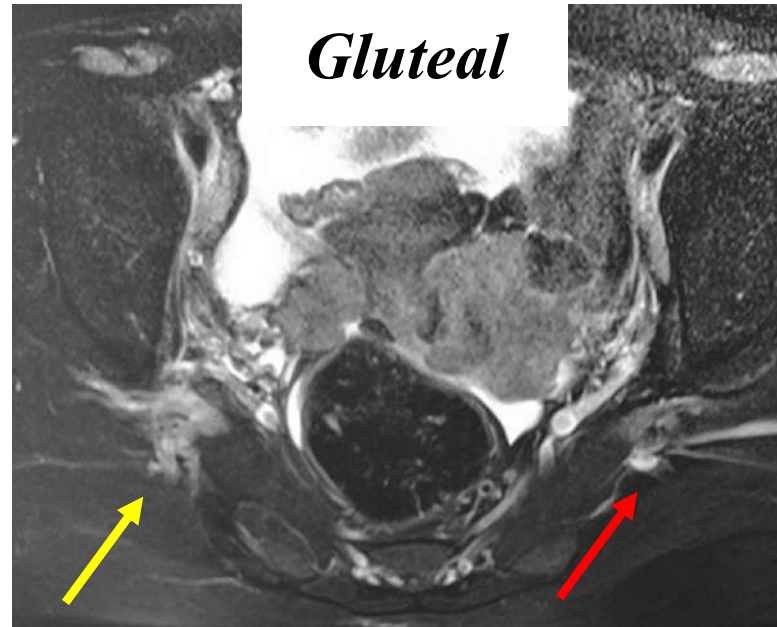




Role of MRI – Beyond yesterday.....?



*Perineural
spread*



Concluding Remark.....



Good clinical practice

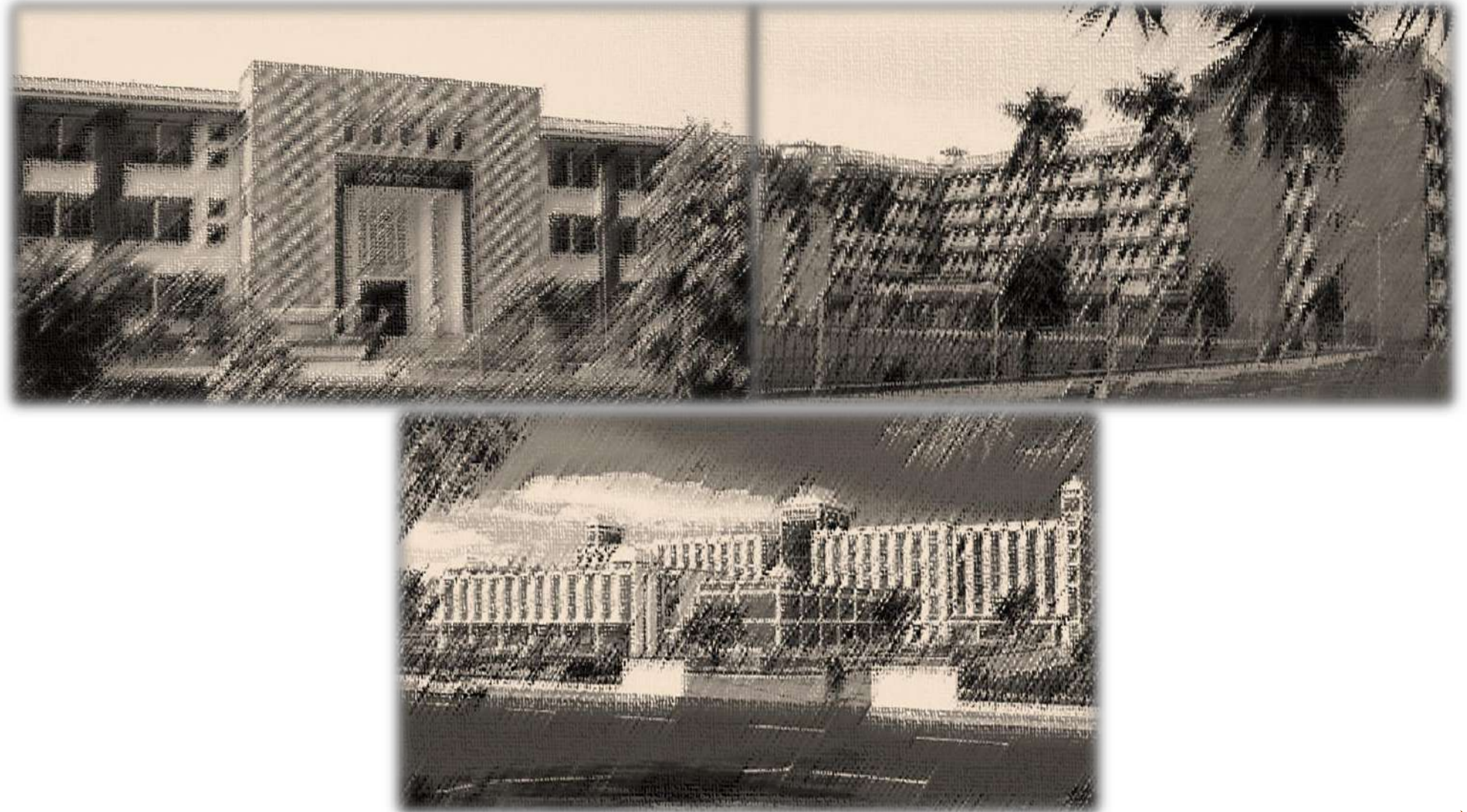
&

improved patient care

Integration of imaging in radiation therapy planning
mandates a good understanding of the same
on the part of a Radiation Oncologist
for best utilization of sophisticated technological
innovations



Greetings from.....



averma@bhu.ac.in ___ *(Dr.)Ashish Verma*