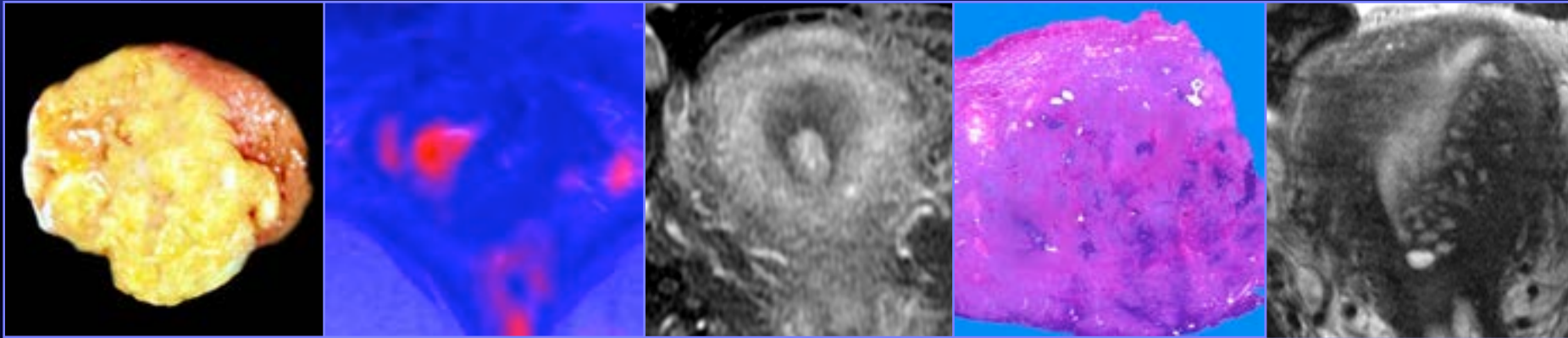


MRI of the Female Pelvis: When, Why and How ?



Caroline Reinhold, MD, MSc

Department of Diagnostic Radiology
McGill University Health Center



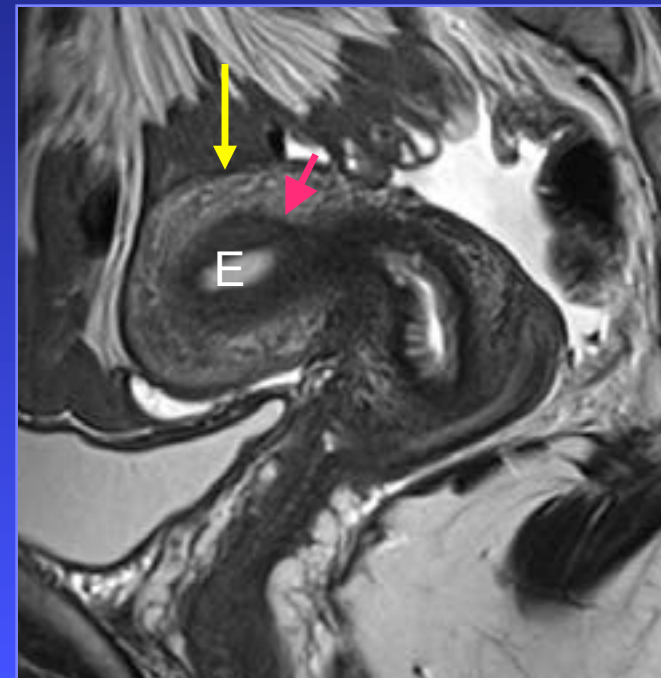
MRI of the Female Pelvis: When, Why and How ?

- Large anatomic coverage
- Multiplanar capability of MRI
- Superior soft tissue contrast
- Detailed anatomic information
- Functional information

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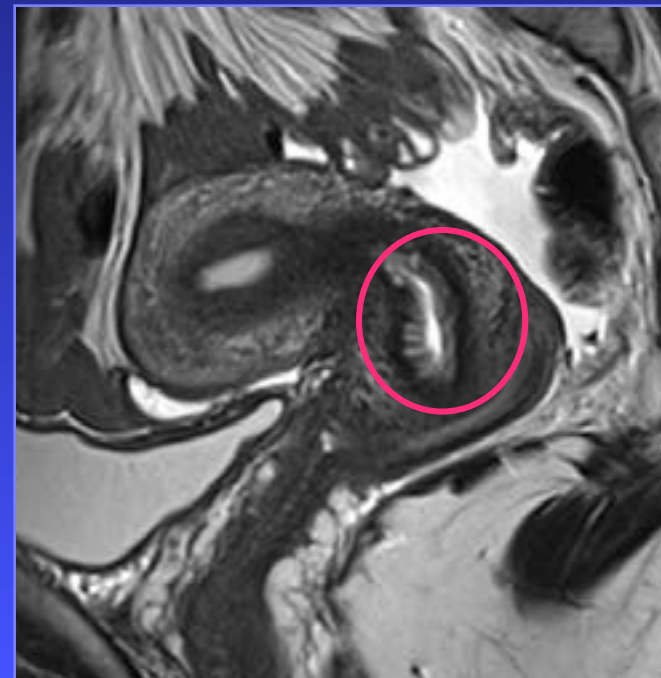
T2W



MRI of the Female Pelvis: When, Why and How ?

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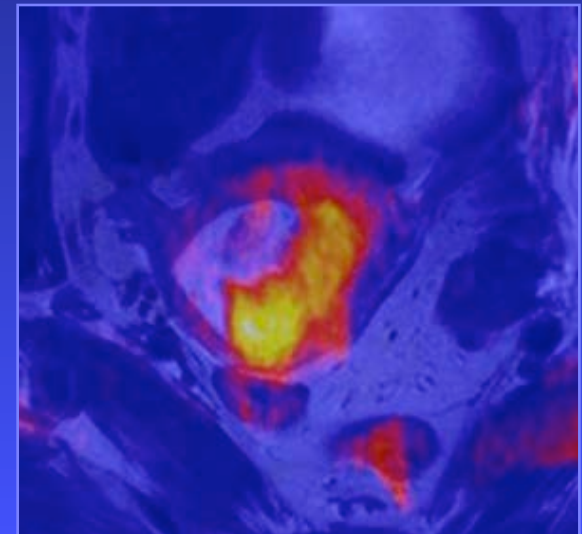
T2W



MRI of the Female Pelvis: When, Why and How ?

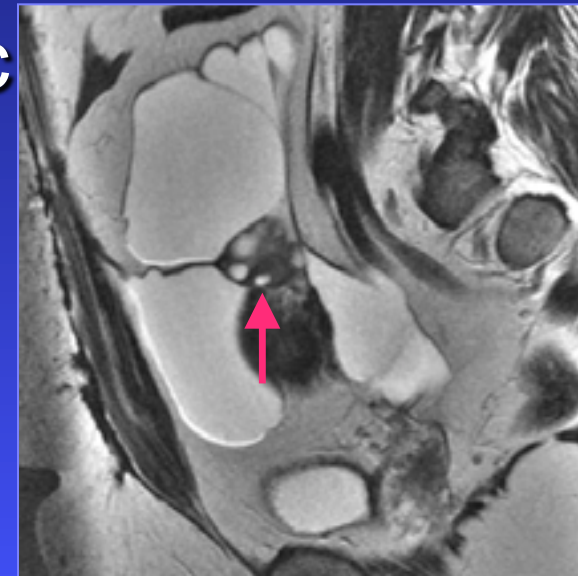
- Large anatomic coverage
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DWI



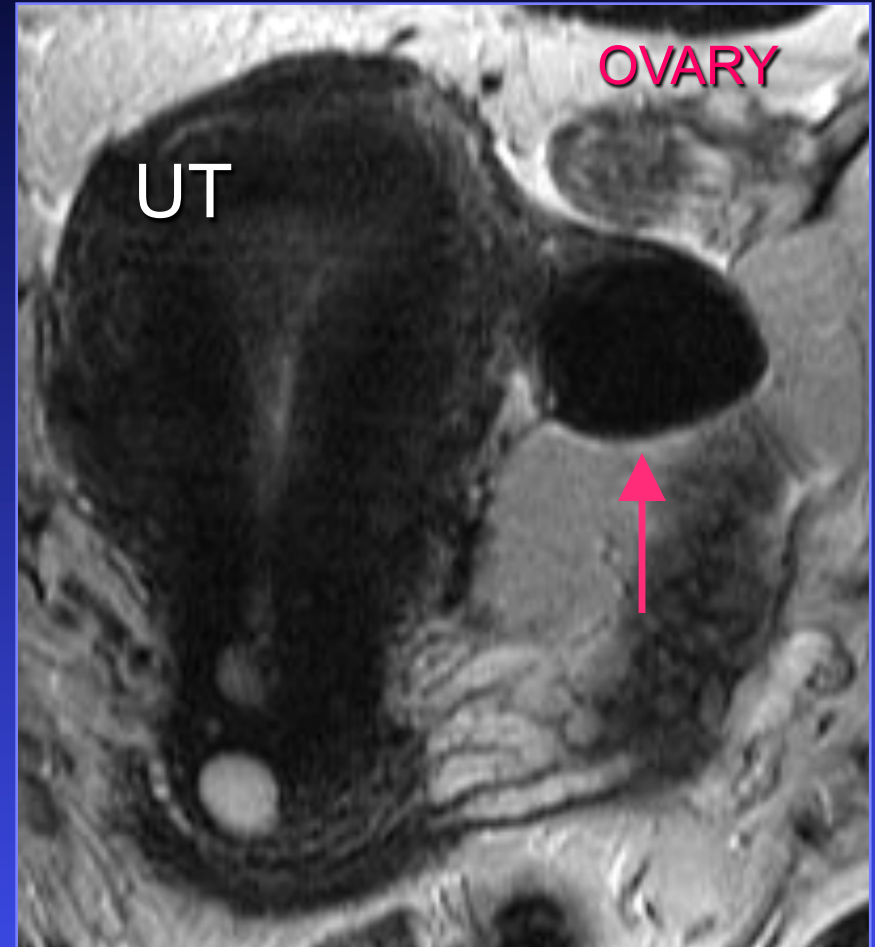
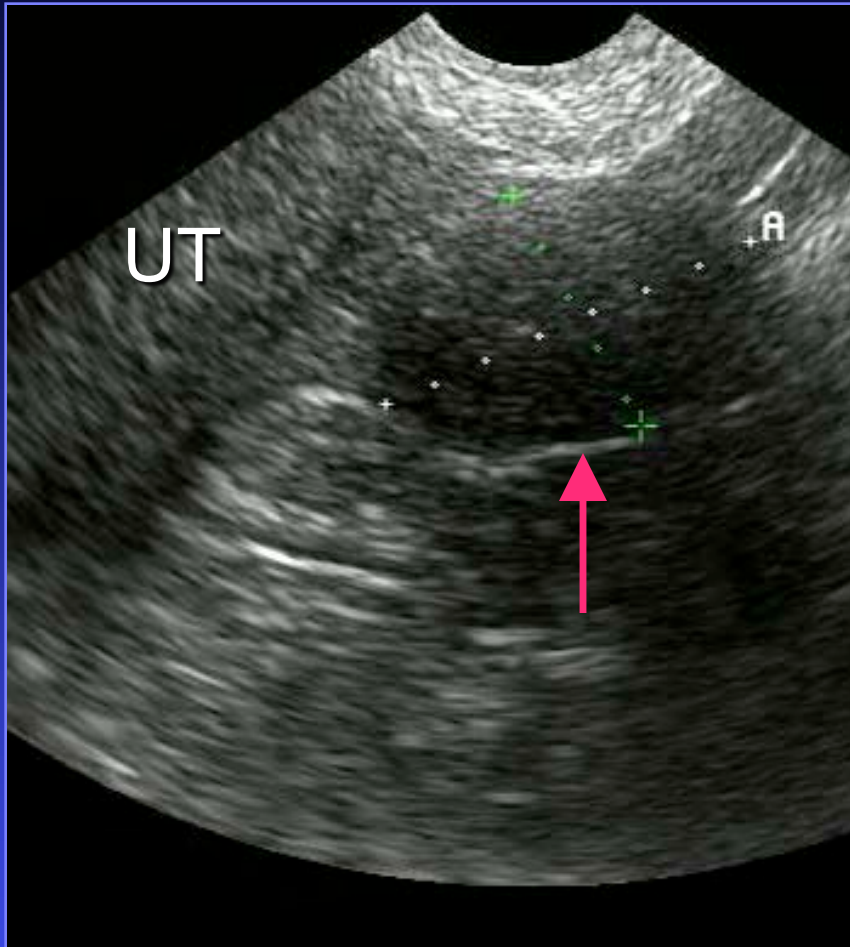
MRI of the Female Pelvis: When ?

- *Problem solving: Indeterminate adnexal mass at US.*
 - Ovarian vs pedunculated leiomyoma
 - Solid vs complex cystic
 - Neoplastic vs non-neoplastic
 - *Benign vs malignant*
 - MRI: Changes Rx.
in up to 25% of cases



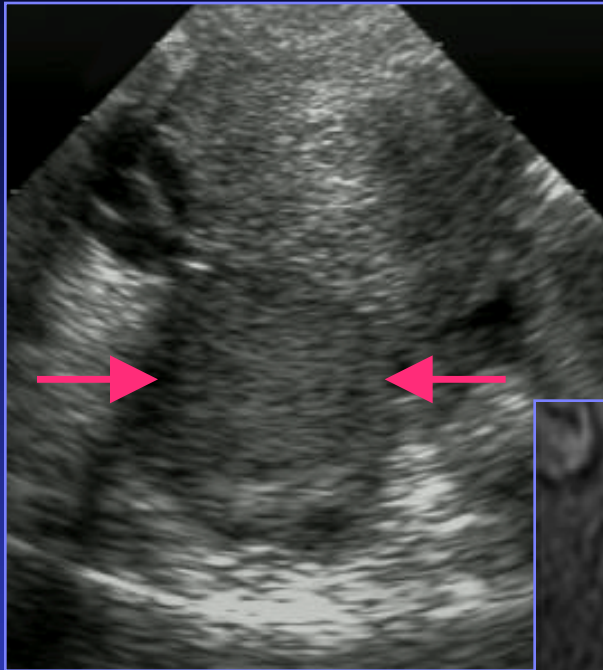
Peritoneal Pseudocyst

Ovarian Mass vs Pedunc. Leiomyoma ?

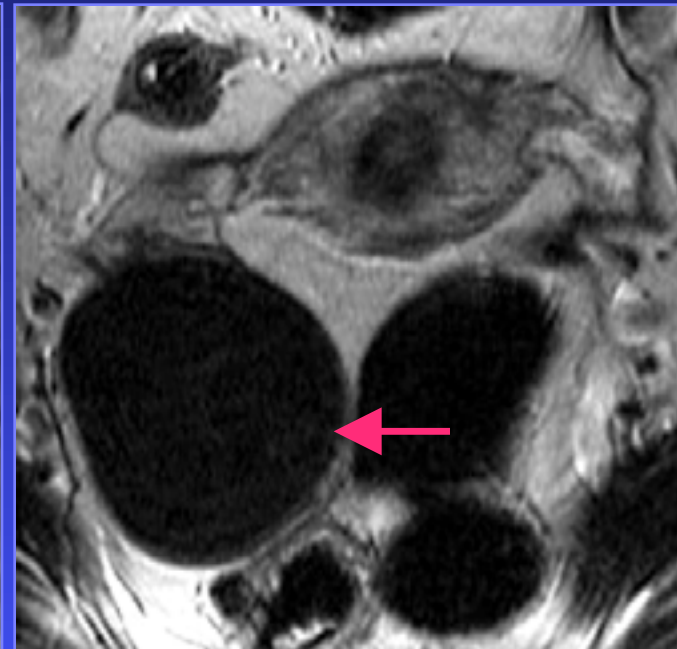
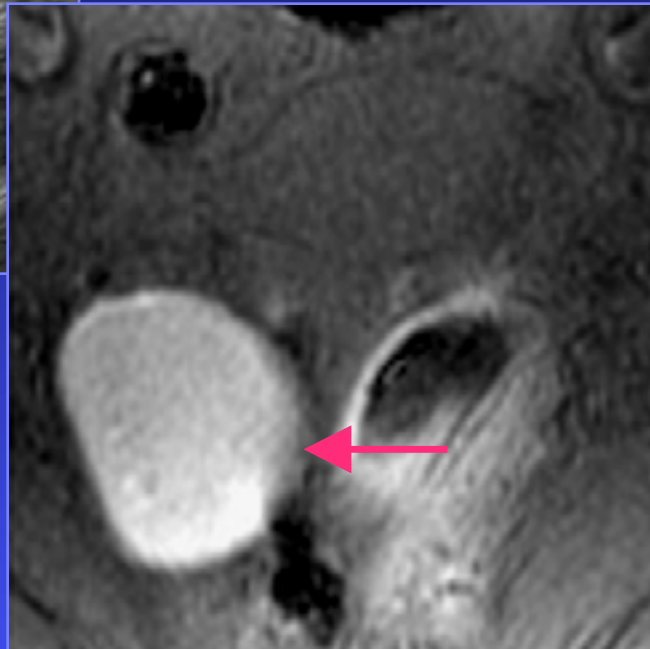


Identify ovaries / splaying myometrium

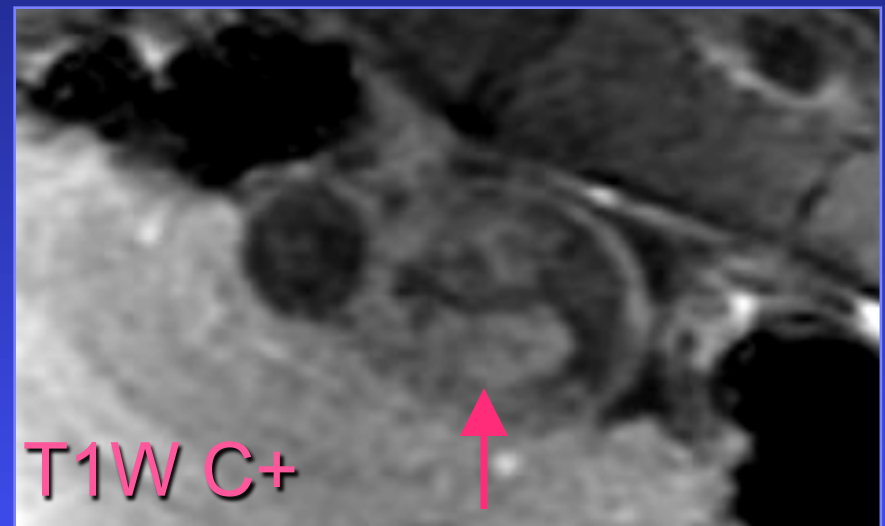
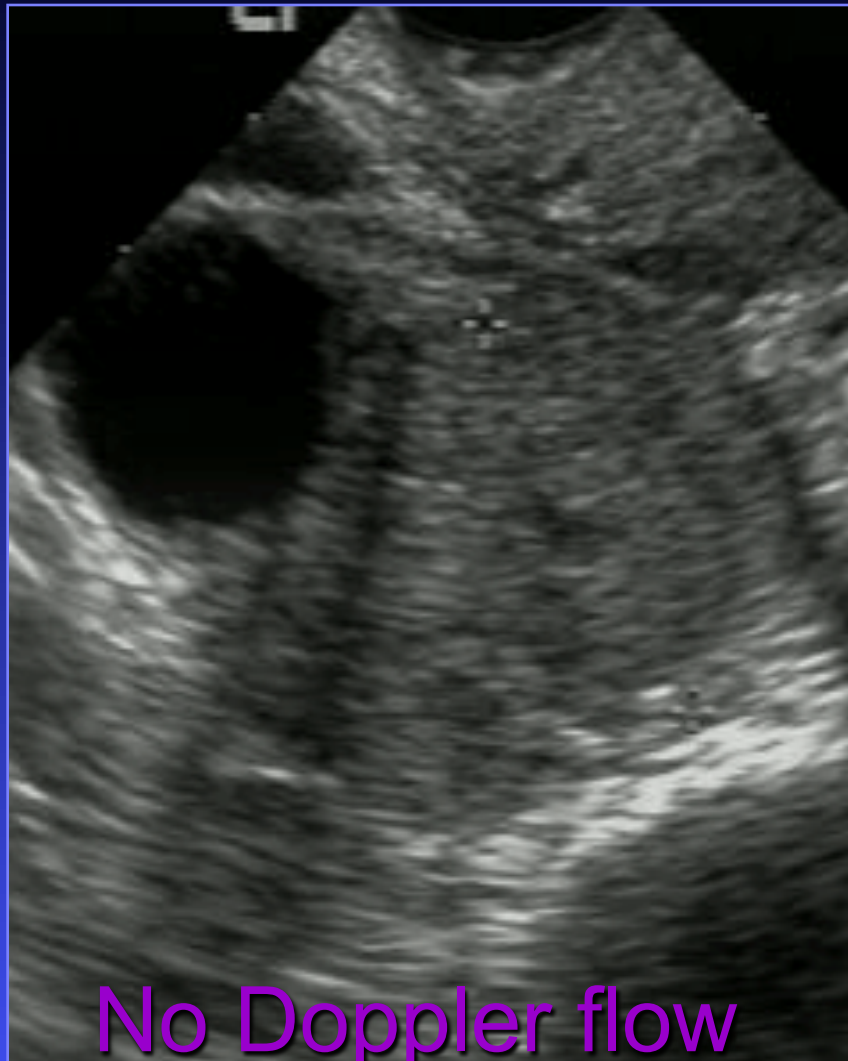
Complex Cystic vs Solid ?



Endometrioma



Neoplastic vs Nonneoplastic



Borderline Serous Cystadenoma

Hydrosalpinx – Multiple Planes



Ax T2W



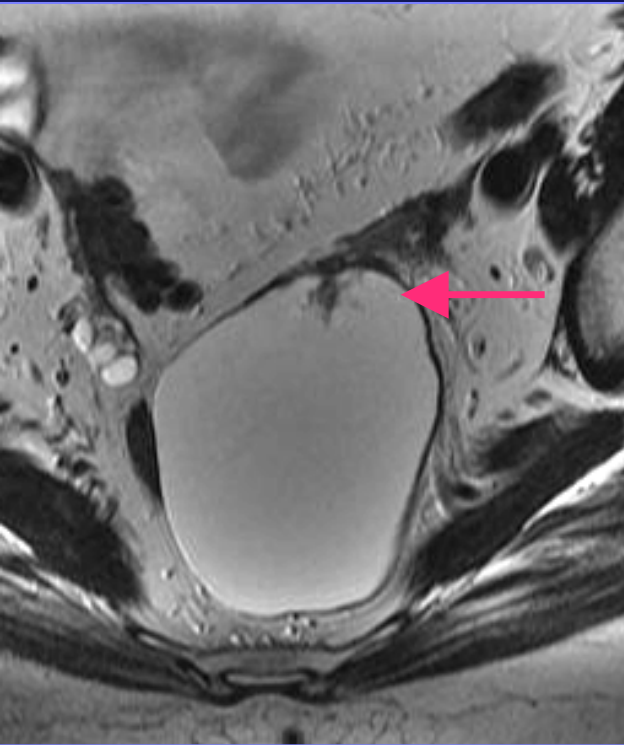
Cor T2W

Adnexal Mass Charact: Why?

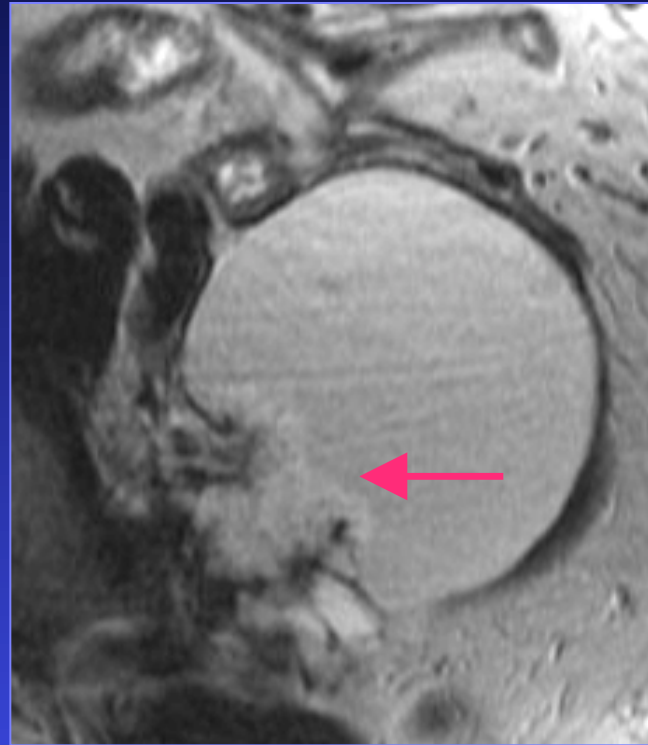
- Optimal patient management
 - No further follow-up
 - Clinical / imaging follow-up
 - Surgical approach
 - Laparoscopy
 - Laparotomy
- Benign vs Malignant

*ESUR Guidelines for Characterization
of the Indeterminate Adnexal Mass*

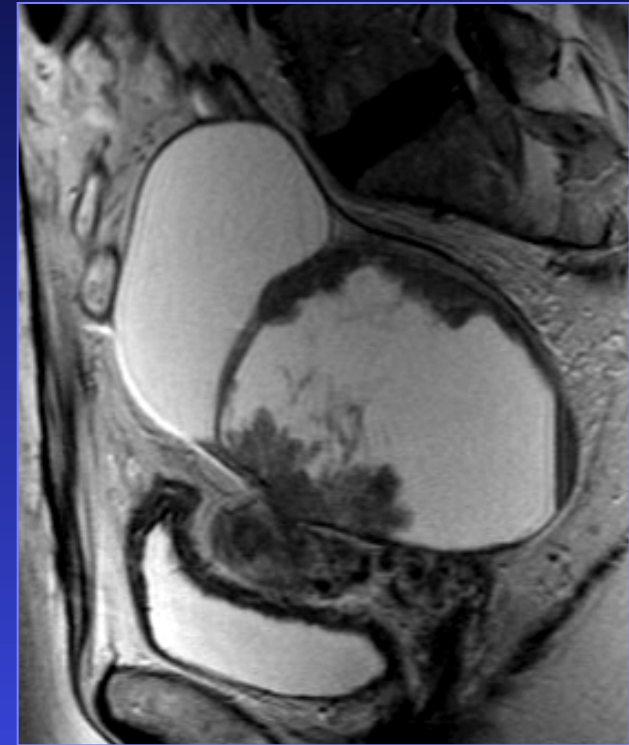
Spectrum: Benign to Malignant



Benign



Borderline



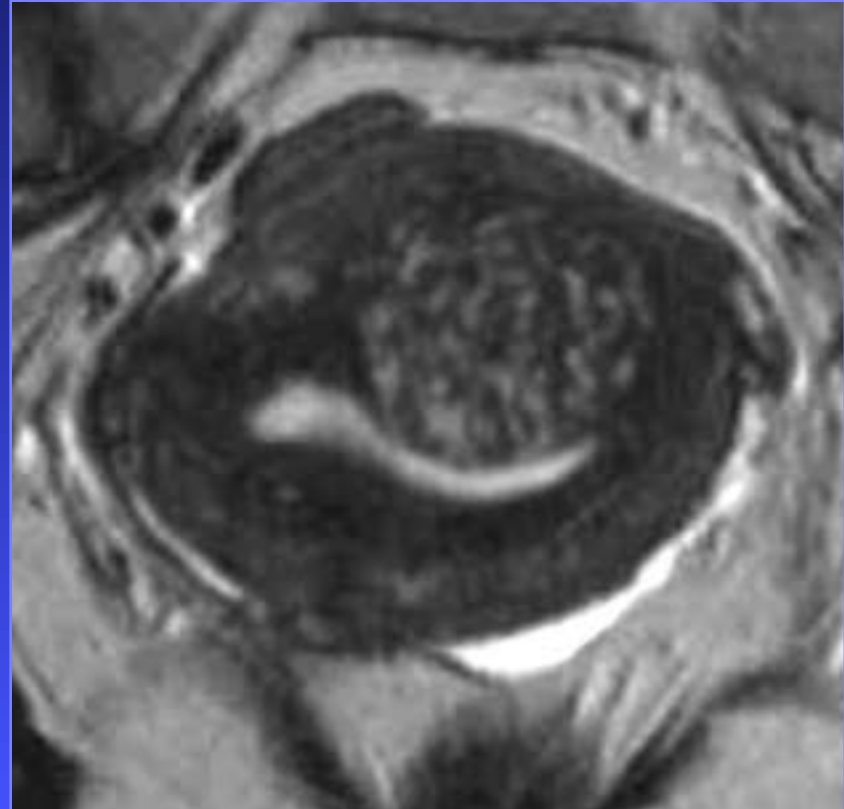
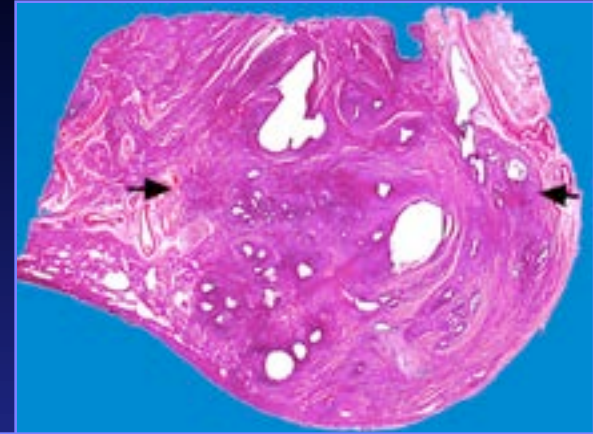
Malignant

MRI of the Female Pelvis: When ?

- Problem solving: Benign uterine disease characterization
 - Adenomyosis vs leiomyomas
 - Adenomyosis vs endometriosis
 - Cystic adenomyosis vs MDA vs hemorrhagic leiomyoma
 - Leiomyoma vs sarcoma
- Rx. Planning for leiomyomas

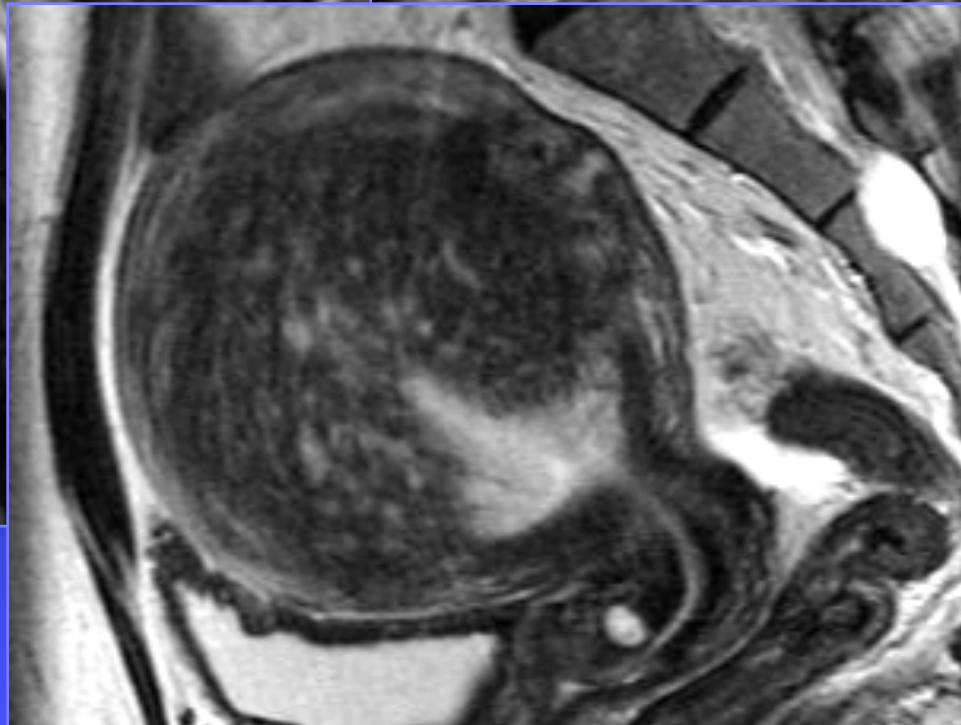
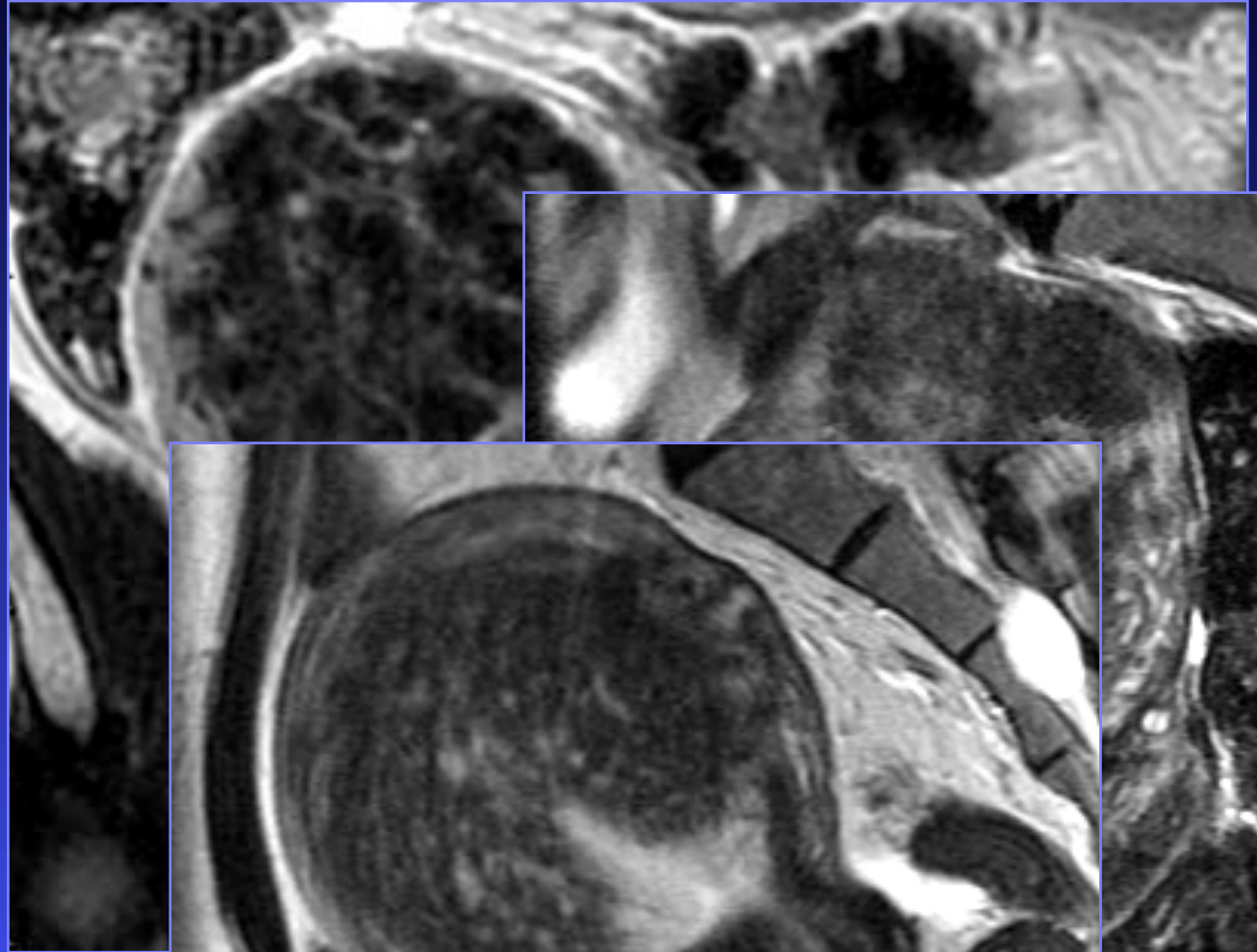
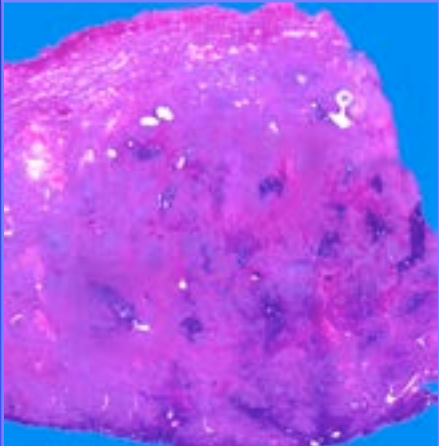
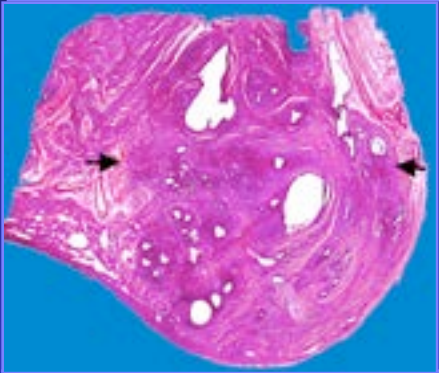
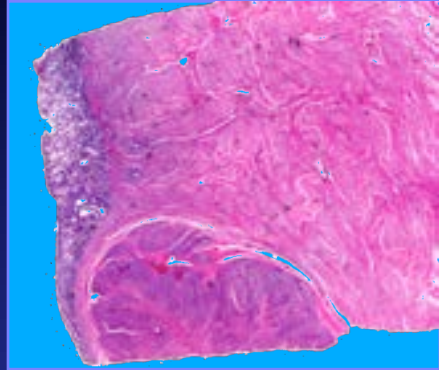
Adenomyoma

- Circumscribed mass of adenomyosis
- Mass effect
- Ill-defined borders
- Round / elliptical shape

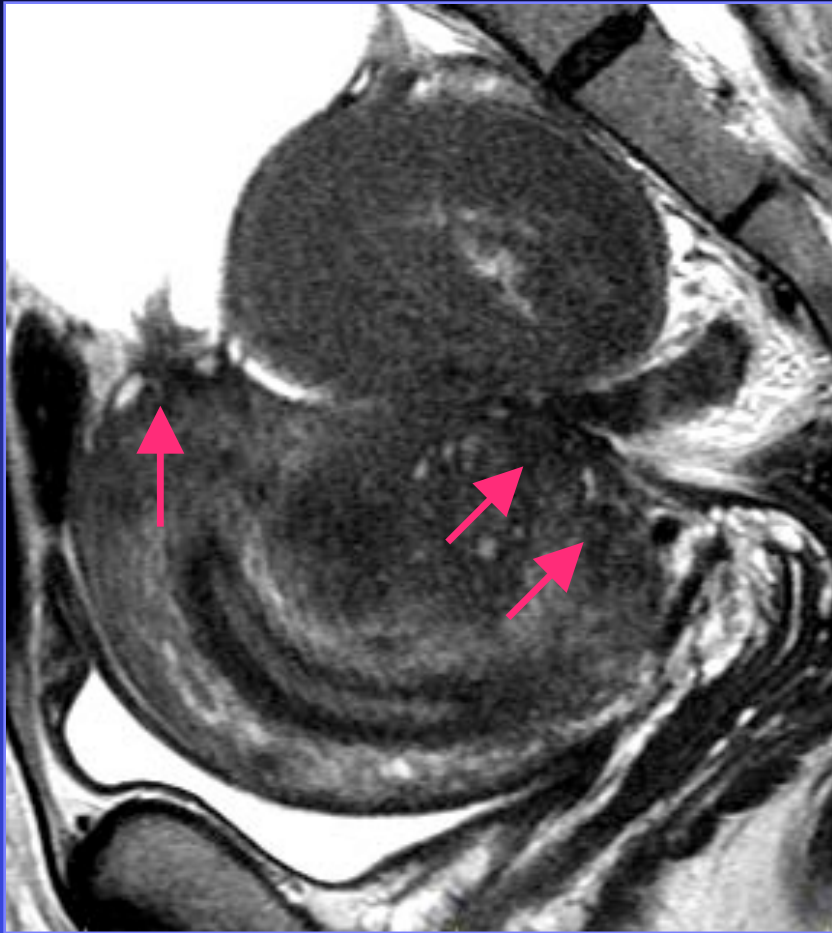


Reinhold C et al. Radiology 1996; 199:151
Tamai K et al. Radiographics 2005; 25:21

Adenomyosis vs Leiomyoma



Adenomyosis vs Endometriosis

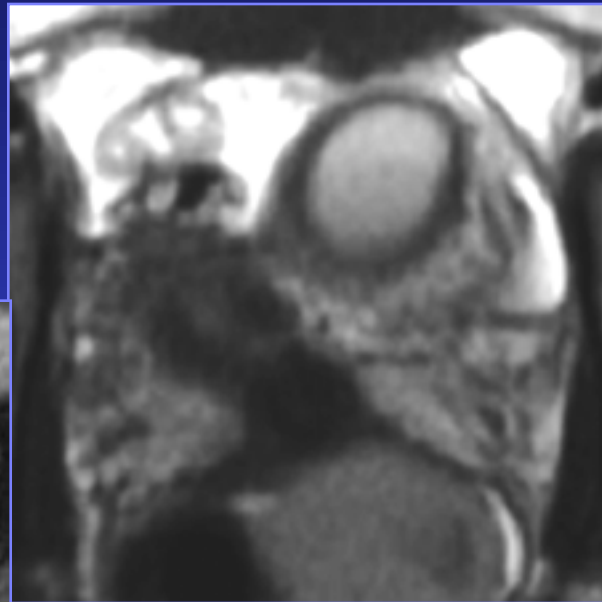
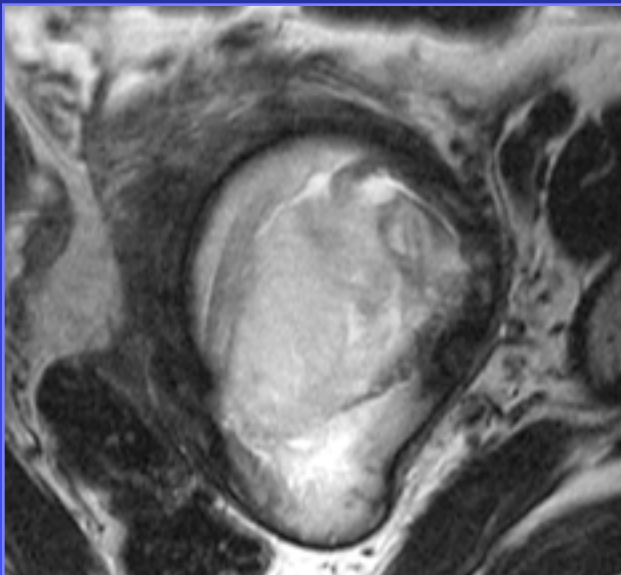


Subserosal Endometriosis

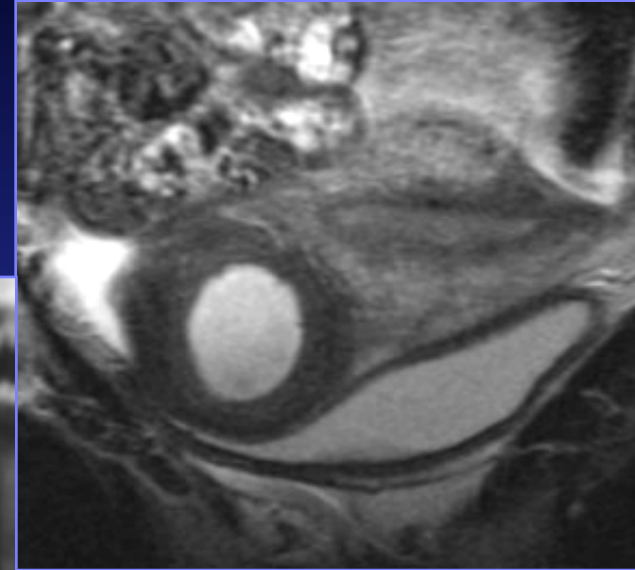
DDX Cystic Adenomyosis – T2

Hemorrhagic myom. mass

- Leiomyoma
 - Thin rim
 - Heterogen.



- Hematometra
 - Single cornua

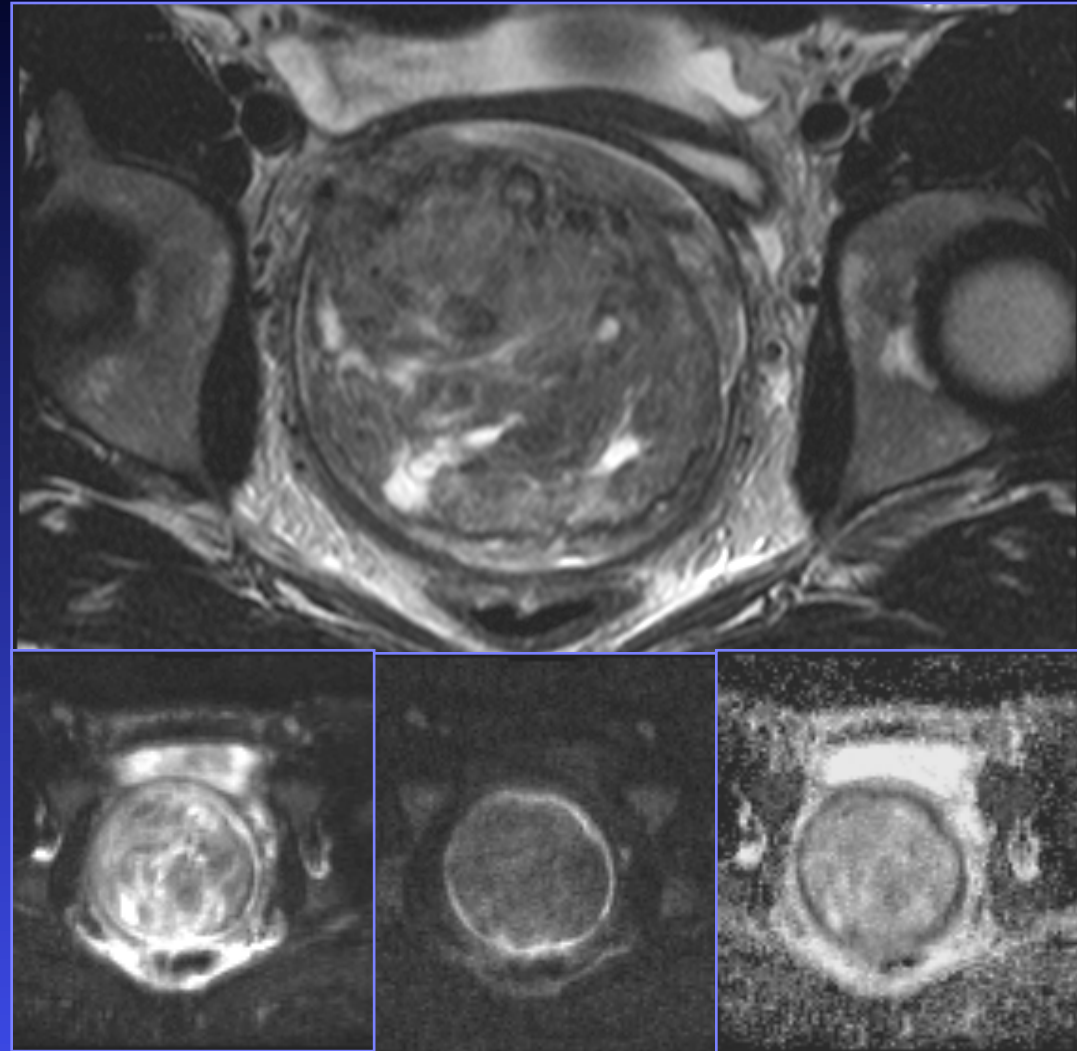


- Cystic adeno.
 - Two cornua
 - Thick rim
 - Homog. content

Leiomyoma vs Sarcoma

DWI

- B1000 ↓
- ADC ↑
- Lower cellularity
- Liquefactive necrosis / fluid



B 50

B 1000

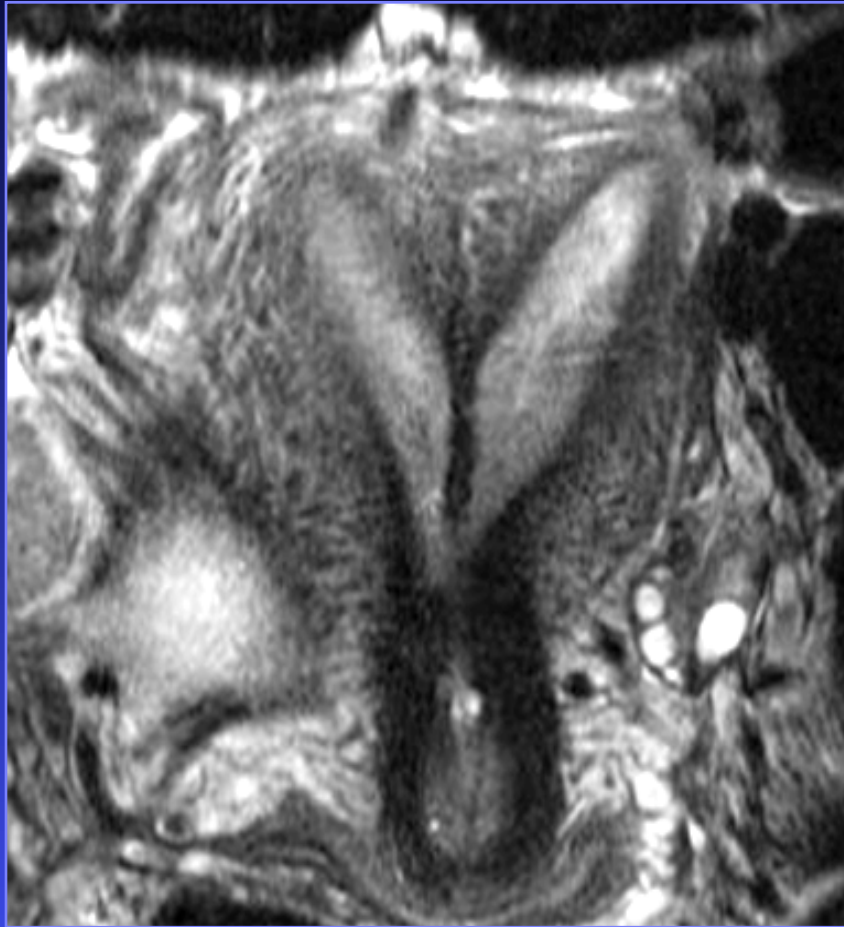
ADC

MRI of the Female Pelvis: When ?

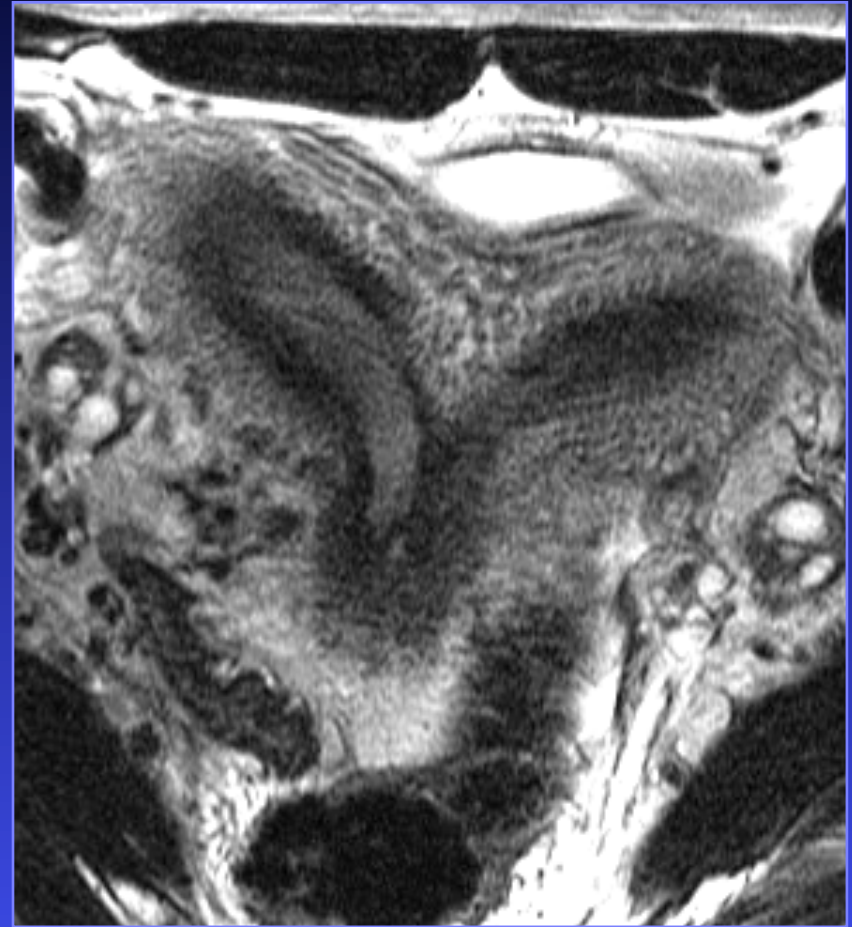
■ Modality of choice

- MDA, complex anomalies
- Pelvic floor dysfunction
- Periurethral / vaginal pathology
- Gynecological malignancies
 - Initial staging
 - Assessment of Rx. response

Septate

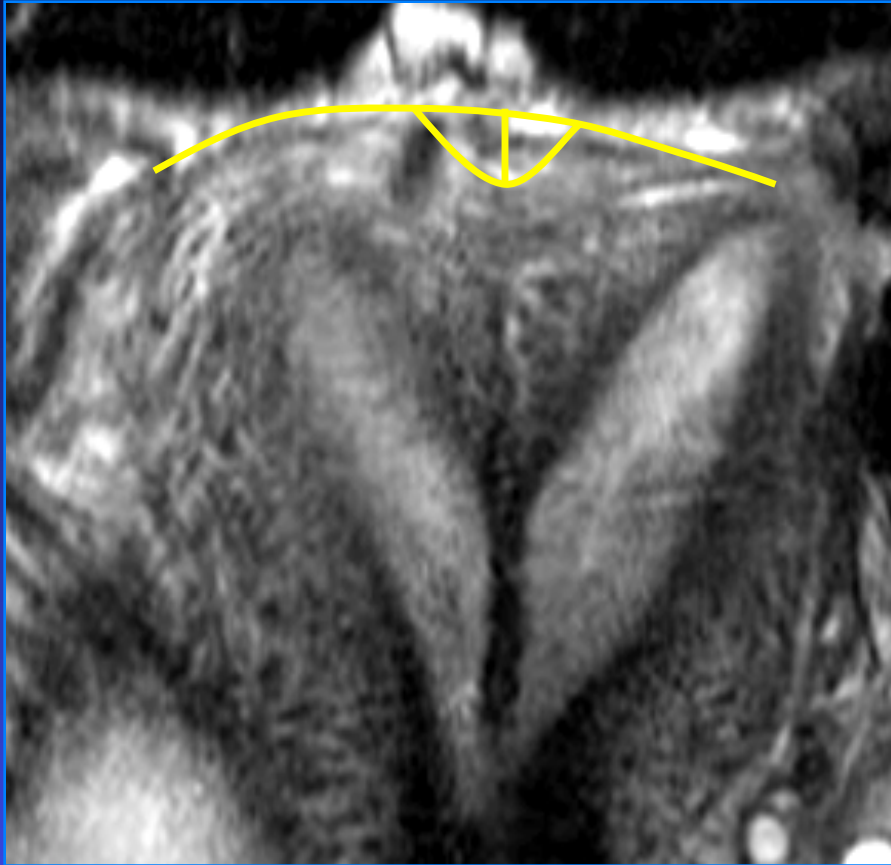


Bicornuate



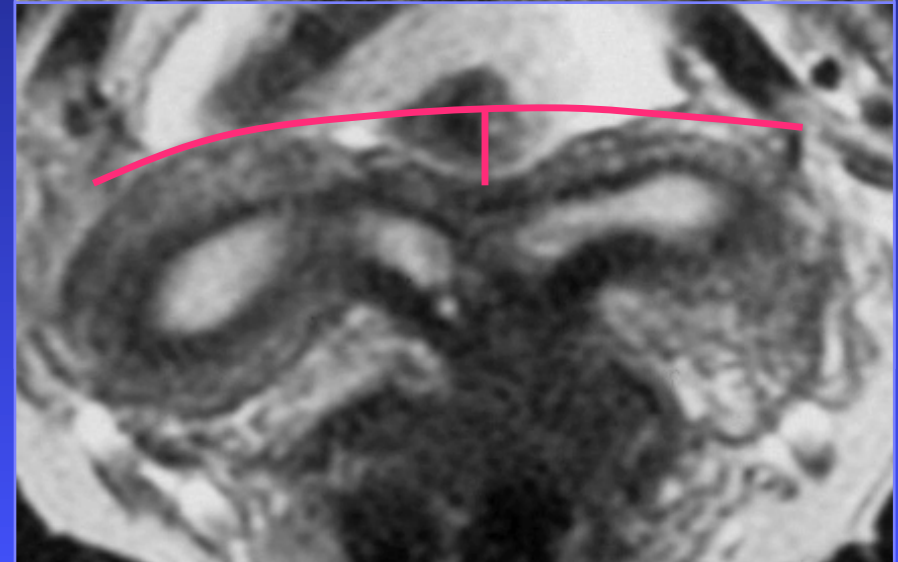
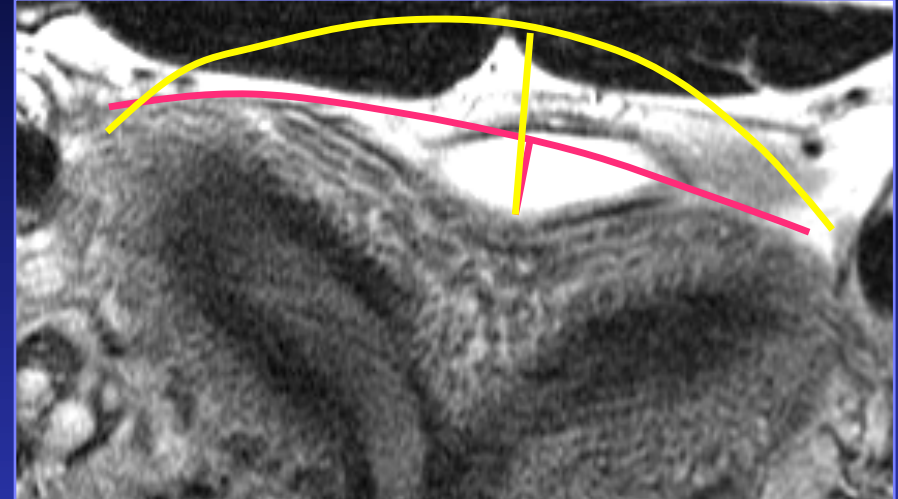
Fundal dip \leq 1cm

Septate



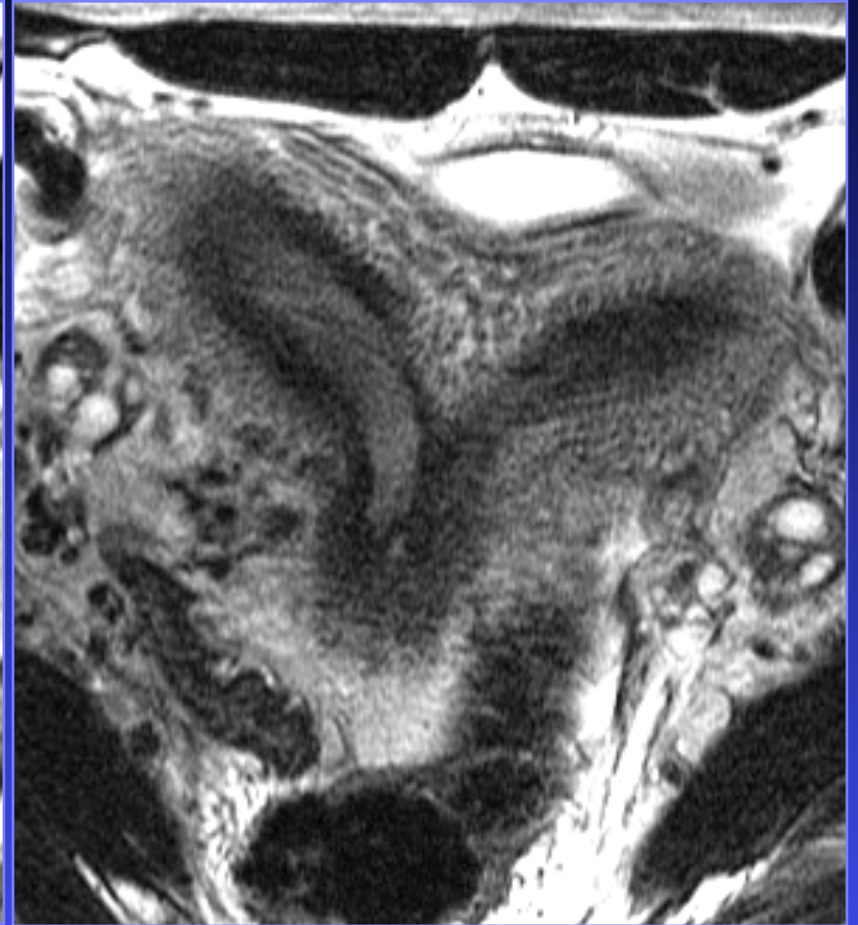
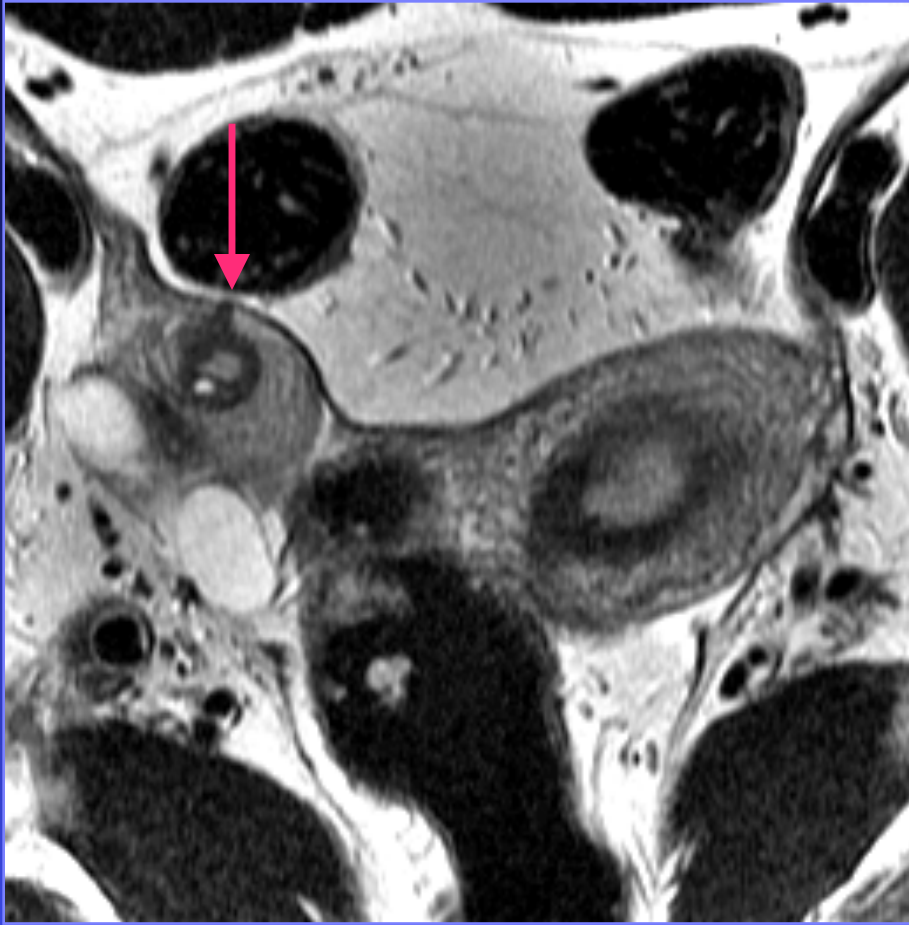
Fundal dip $\leq 1\text{cm}$

Bicornuate



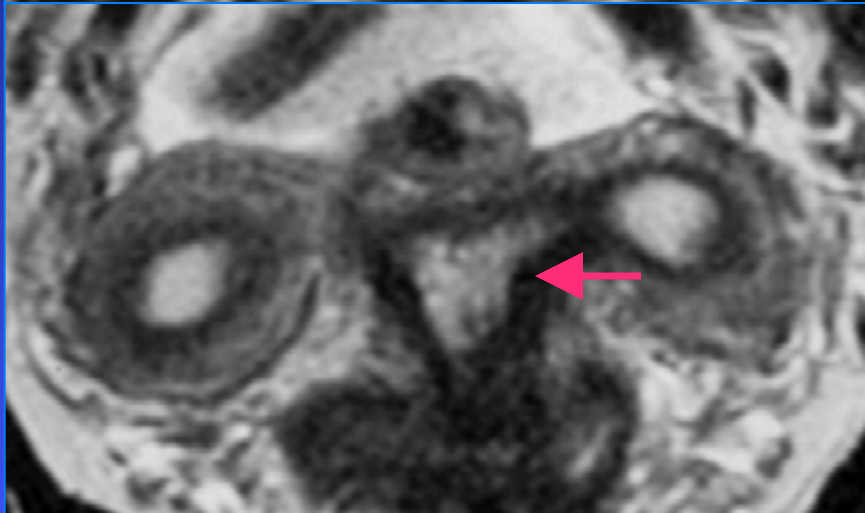
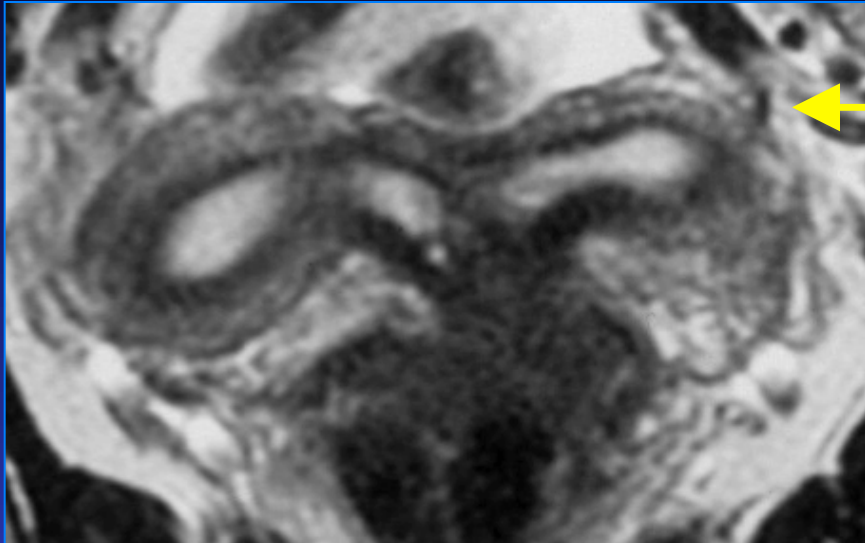
Unicornuate

Bicornuate



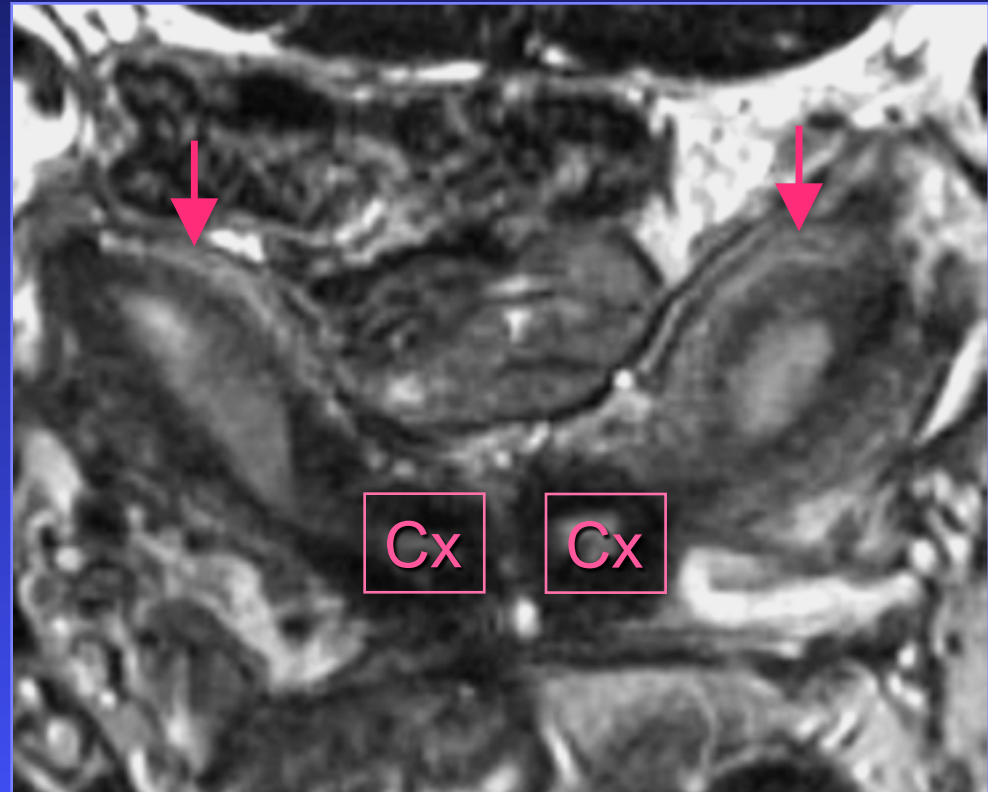
Asymmetric horns

Bicornuate



Didelphys

Communicating horns



MRI of the Female Pelvis: When ?

■ Modality of choice

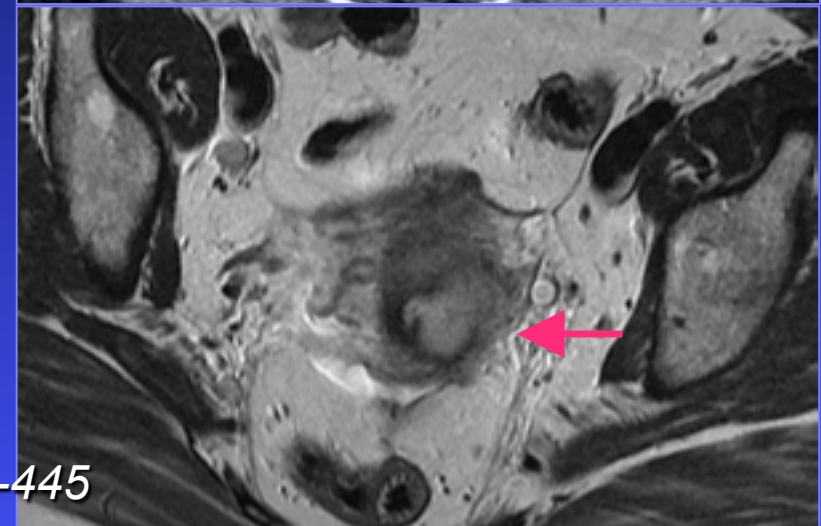
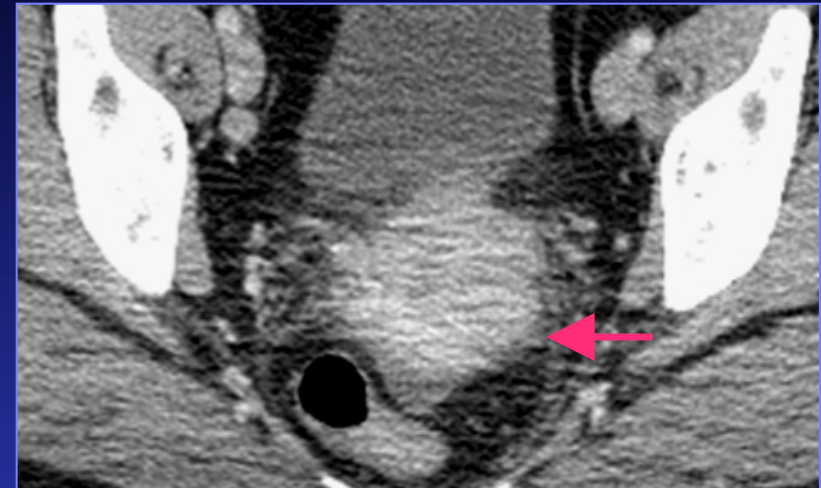
- MDA, complex anomalies
- Pelvic floor dysfunction
- Periurethral / vaginal pathology
- Gynecological malignancies
 - Initial staging
 - Assessment of Rx. response

Rx. Stratification - Today

Stage IB1 / IIA1	< 4 cm	Confined to cervix or upper vagina
Stage IB2 / IIA2	> 4 cm	
Stage IIB	Parametrial invasion	
Stage IIIA	Lower 1/3 vagina	
Stage IIIB	Sidewall, hydronephrosis	
Stage IVA	Bladder, rectal mucosa	
Stage IVB	Extension beyond pelvis	

Why ? : Determination of Tumour Size

- Greatest tumour dimension
 - MR >> CT / CE
- Tumour delineation
 - CT: 35-73%
 - MR: 80-94%
- Increased precision of targeted RadRx.

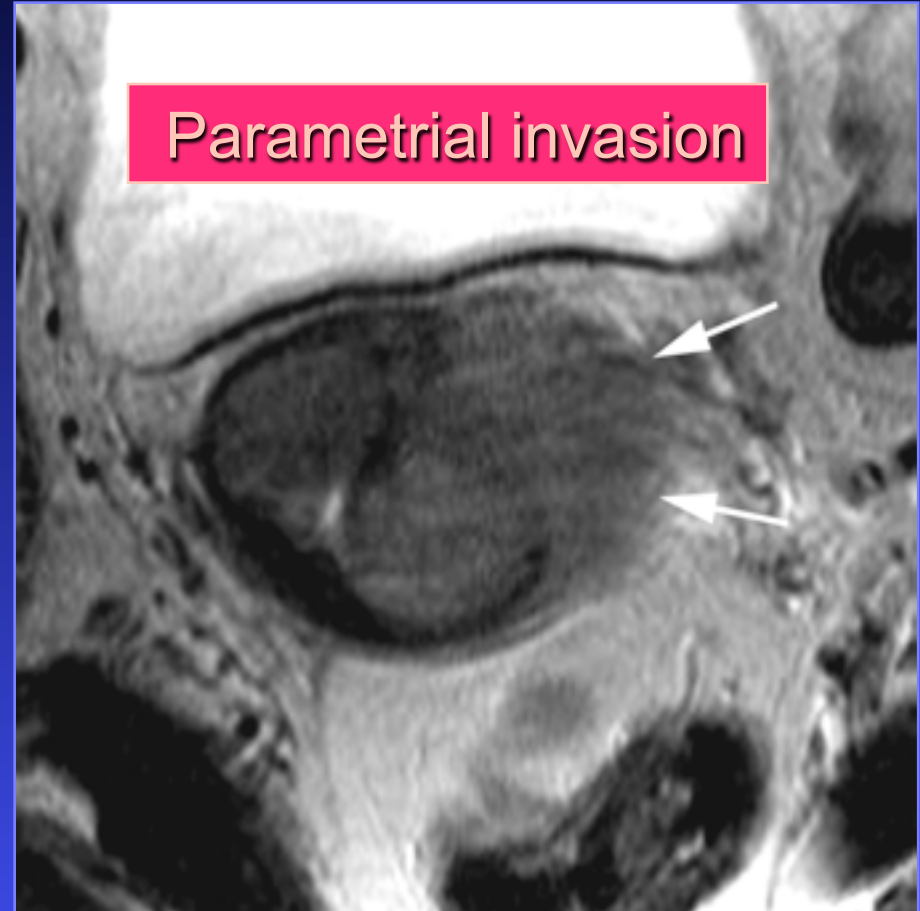
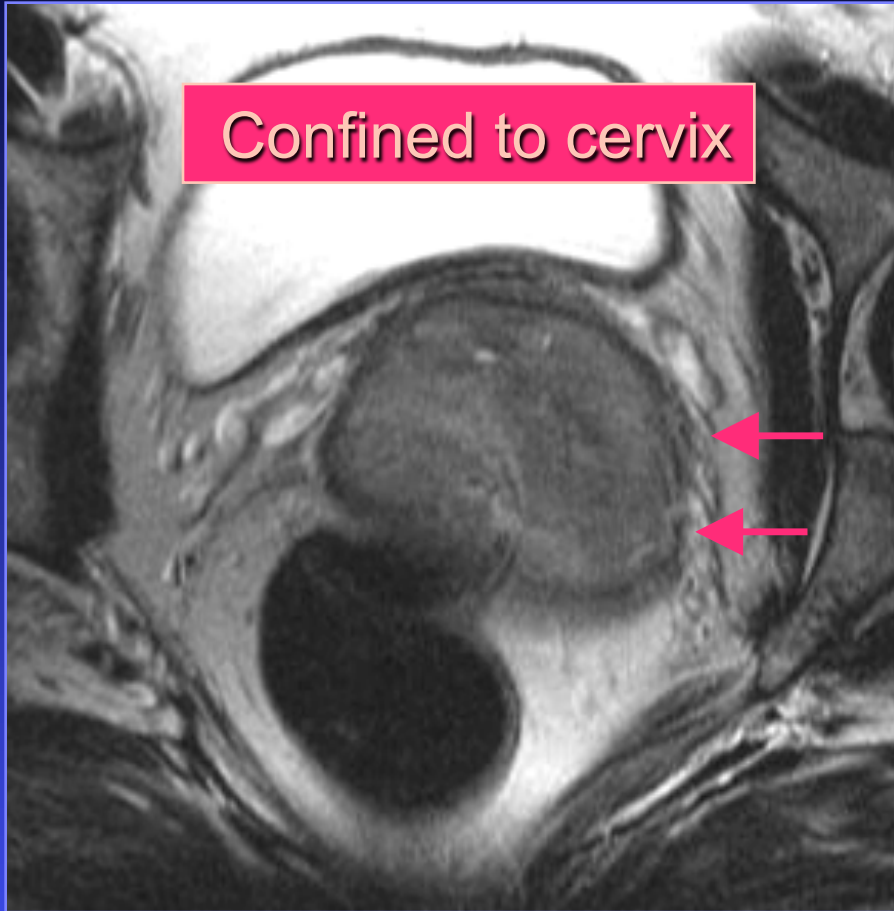


Okamoto Y et al. Radiographics 2003; 23:425-445

Prasad TV et al. IJMR 2014; 139:714-719

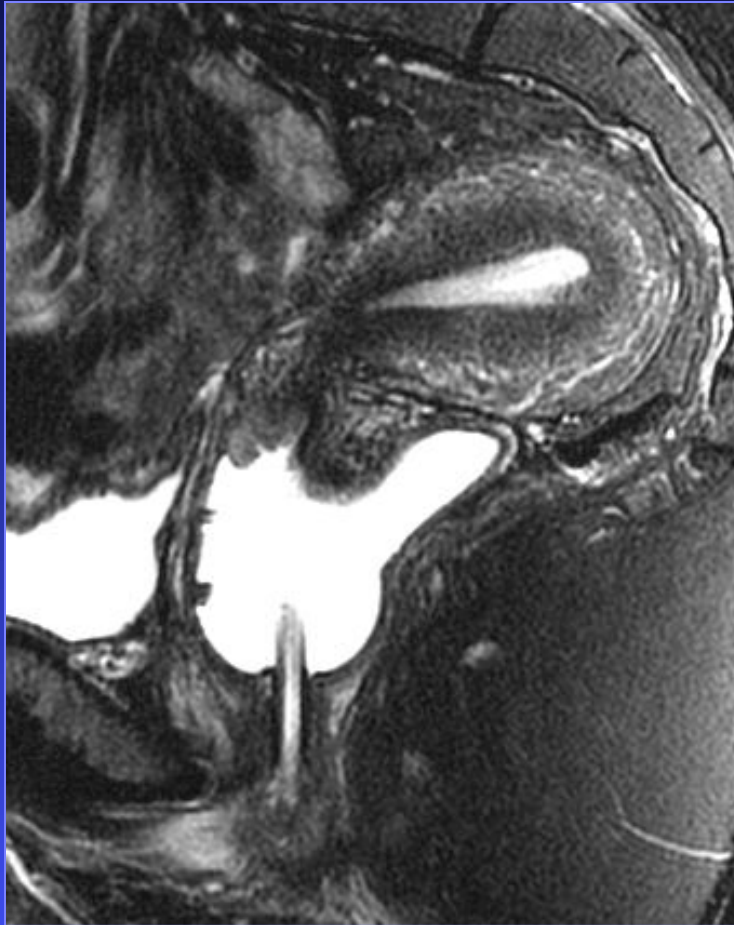
Mitchell D.,...Reinhold C. et al. JCO 2006 ACRIN/GOG Multicenter Study

Why ? : Stage IB vs IIB



Complete disruption of FS

Vaginal Invasion- Stage IB vs IIA

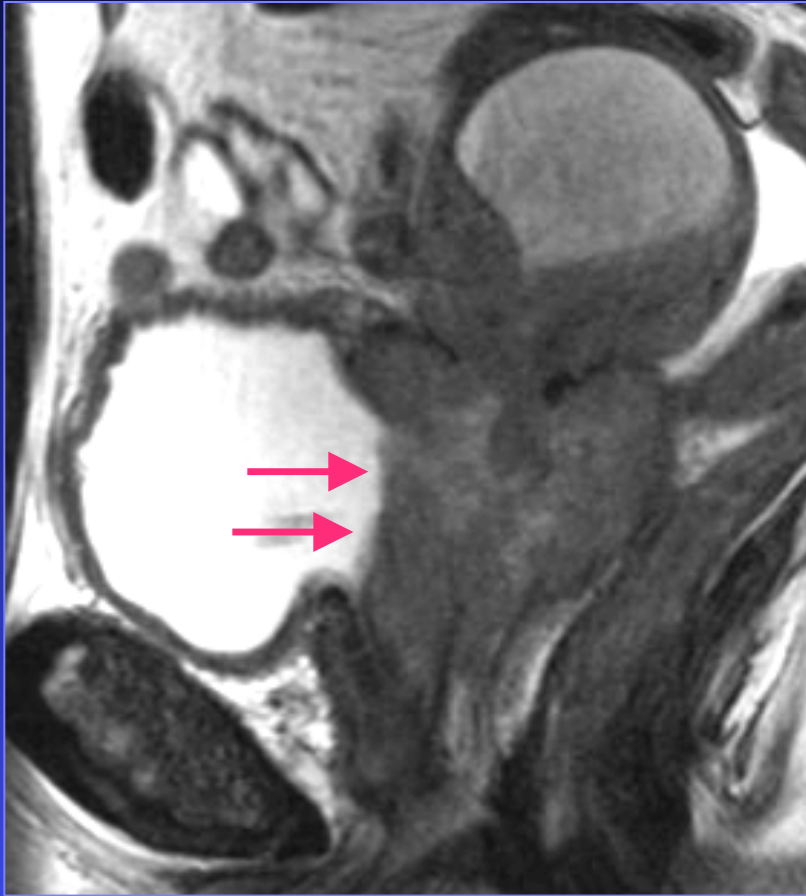


Vaginal Gel



Courtesy Dr. Masoom Haider, University of Toronto

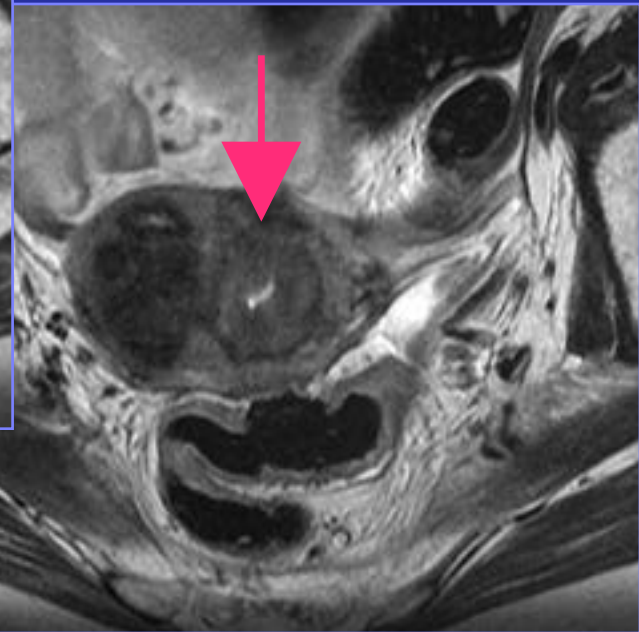
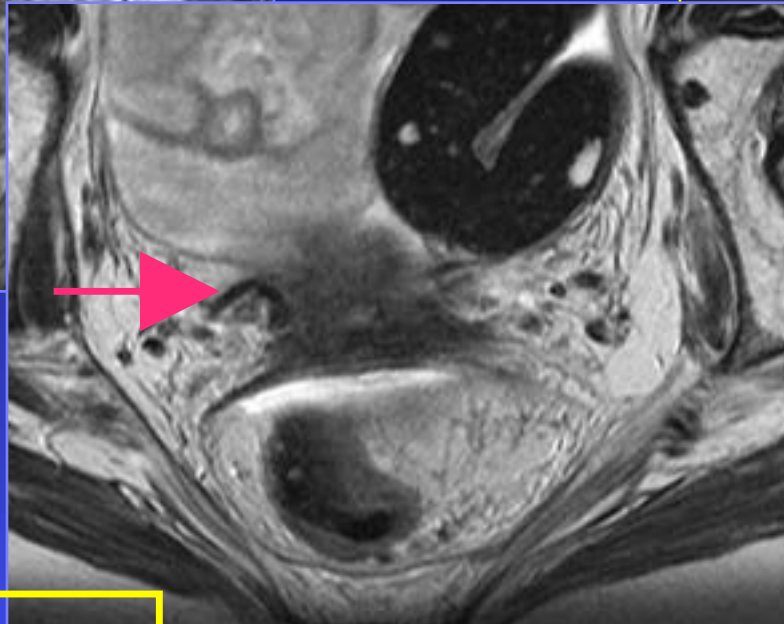
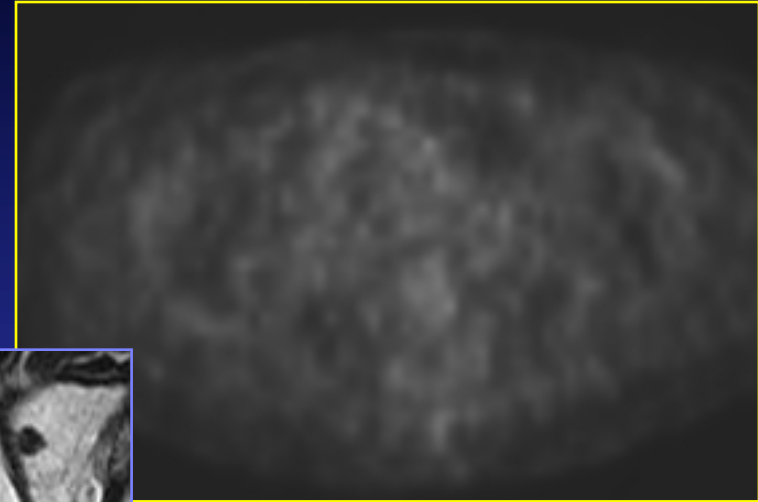
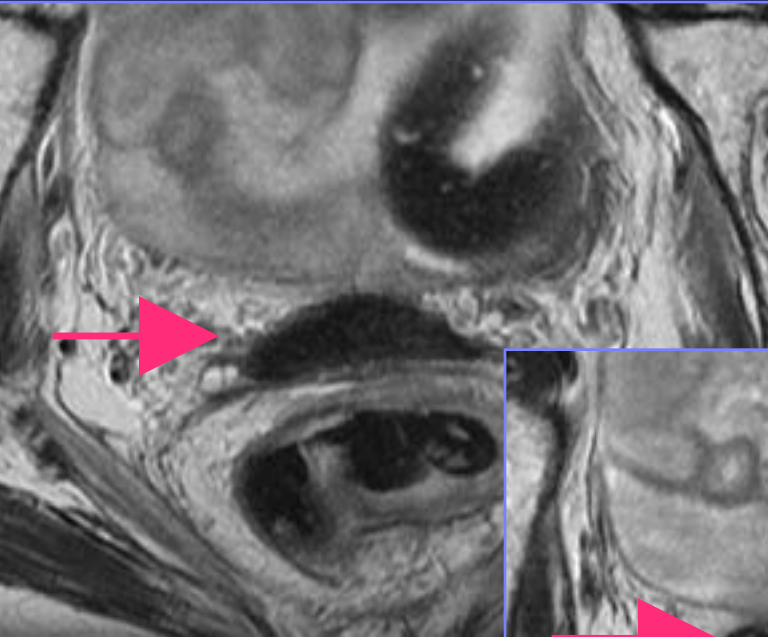
Stage IVA: Bladder Mucosal Involvement



2 Patients, Gr. 3 SCC

Sag T2

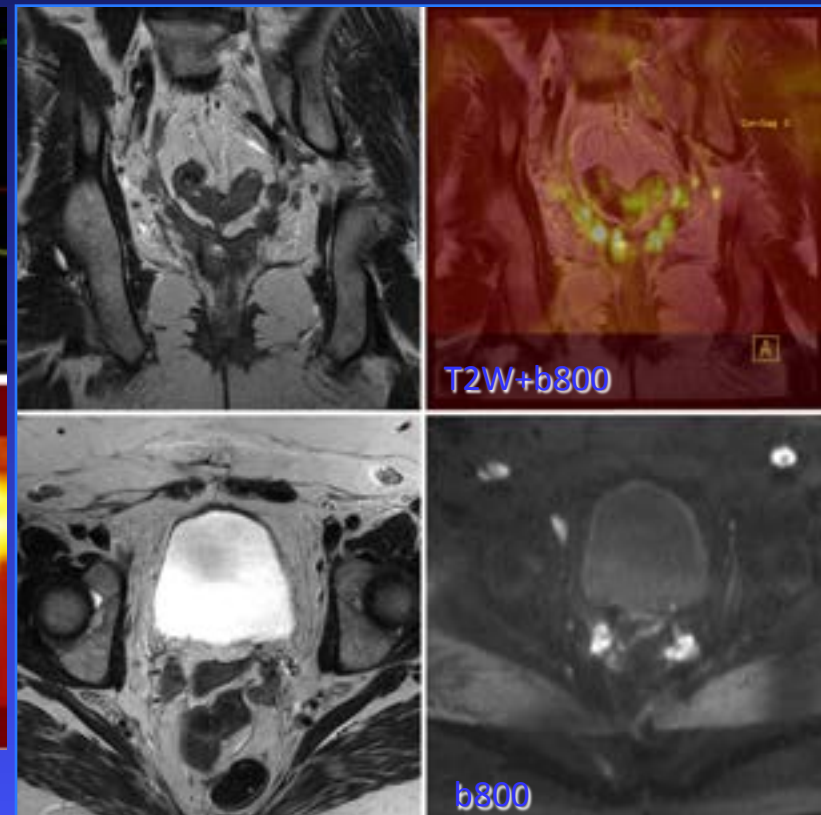
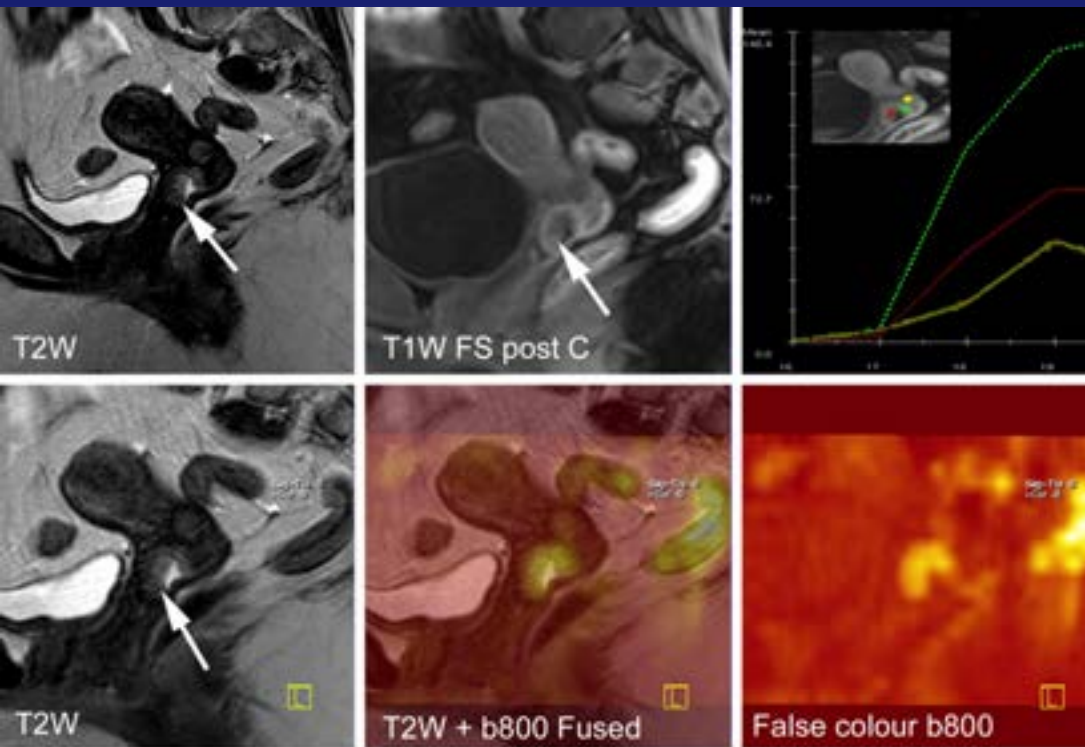
Early Response: DWI



Post Rx – 2 mos

Low perfusion with DCE-MRI predicts poor local tumor control in SCC of the cervix

53 y.o., G3 SCC. Radical TAH & BSO with vault brachytherapy



1/2009 – highly cellular but low blood flow

7/2009 – venous invasive recurrence

Endometrial Ca - Prognosis

- Depends on a number of factors
 - Tumour Stage (FIGO)
 - Depth of myometrial invasion
 - Cervical stromal invasion
 - Nodal status
 - Tumour Histology
 - Tumour Grade
 - Cell type
 - Lymphovascular space invasion

Discordance

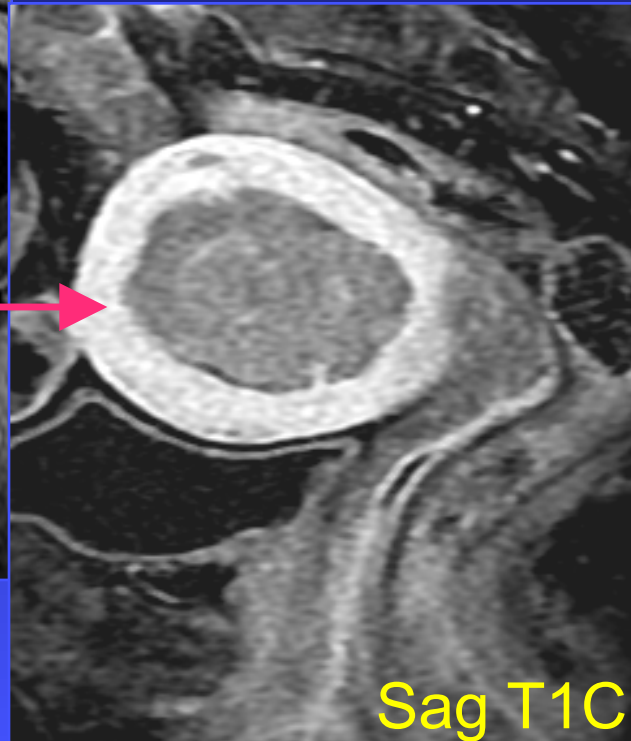
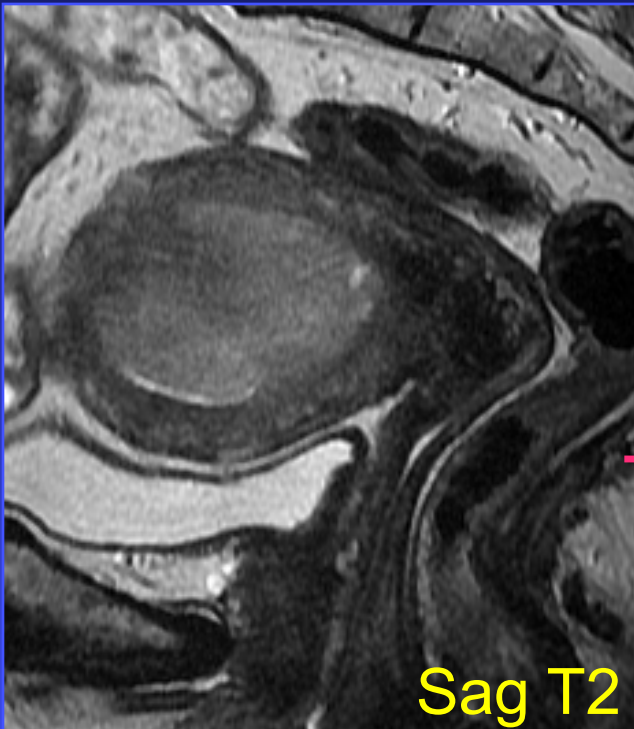
Why ? : Prognosis Stage

- Our role as MR imagers:
 - Establish local disease extent
 - MR can accurately depict depth of myometrial invasion
 - Correlates with LN mets and overall patient survival
- MR incorporated as STD pre-op tool
 - Better risk assignment and surgical planning

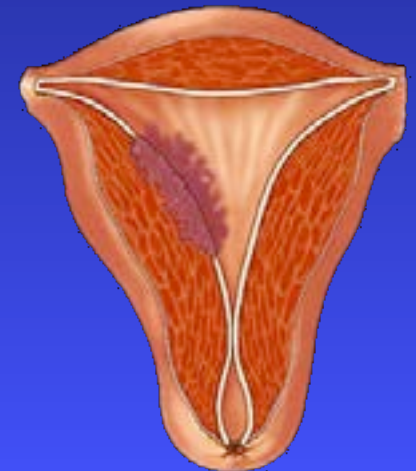
Stage IA

Report: Inner myometrial invasion

Path: Grade 1-2 endometrioid ca.



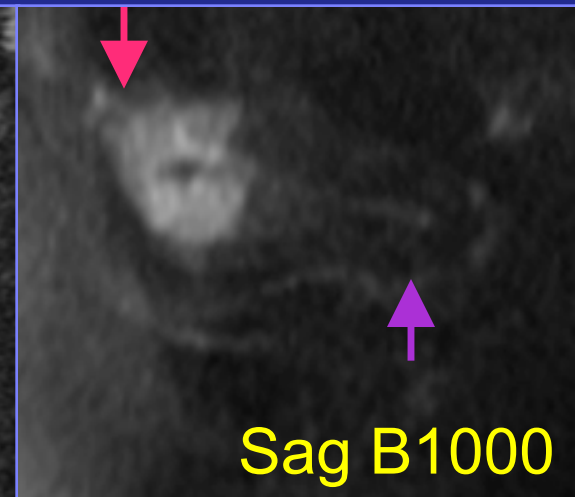
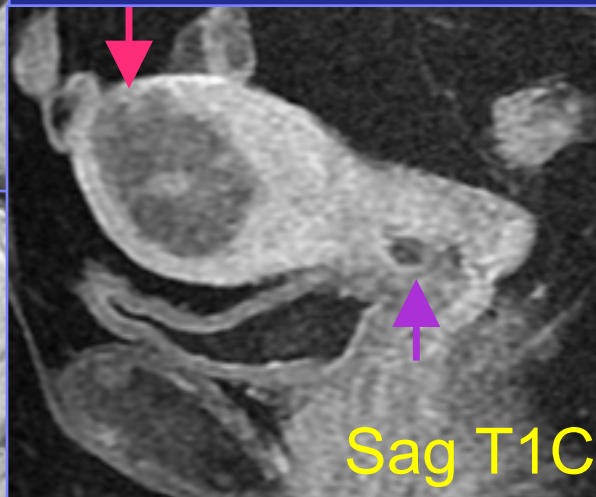
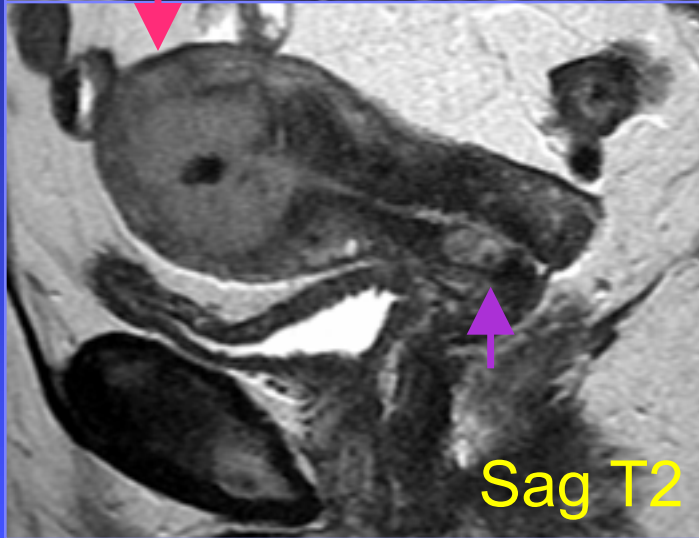
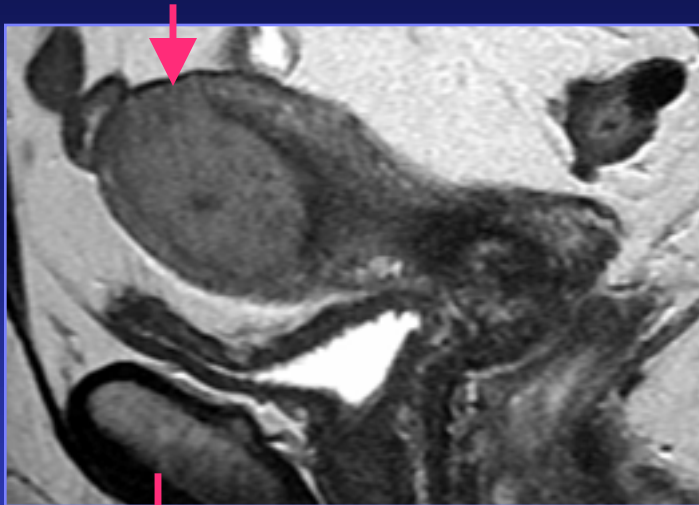
Low Risk



Stage IB

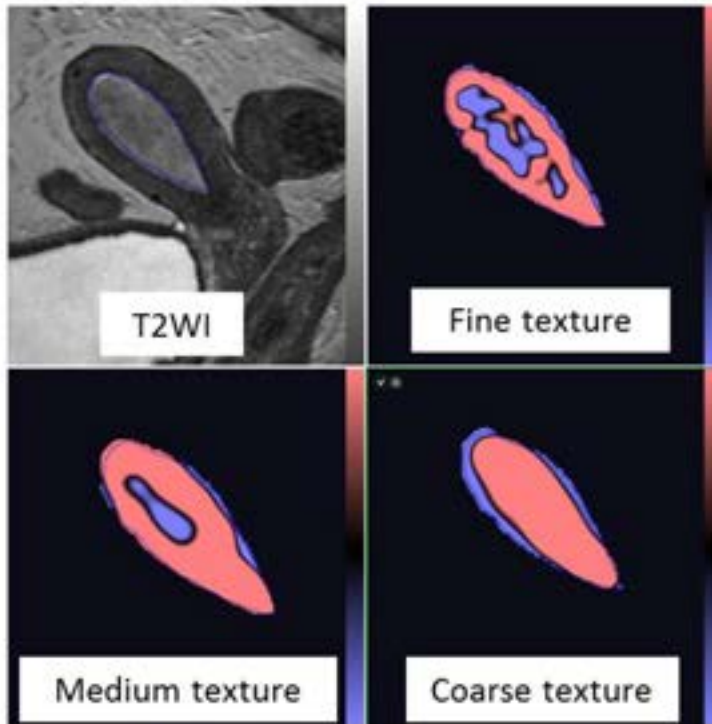
Report: Outer myometrial invasion

Path: Grade 3 endometrioid ca

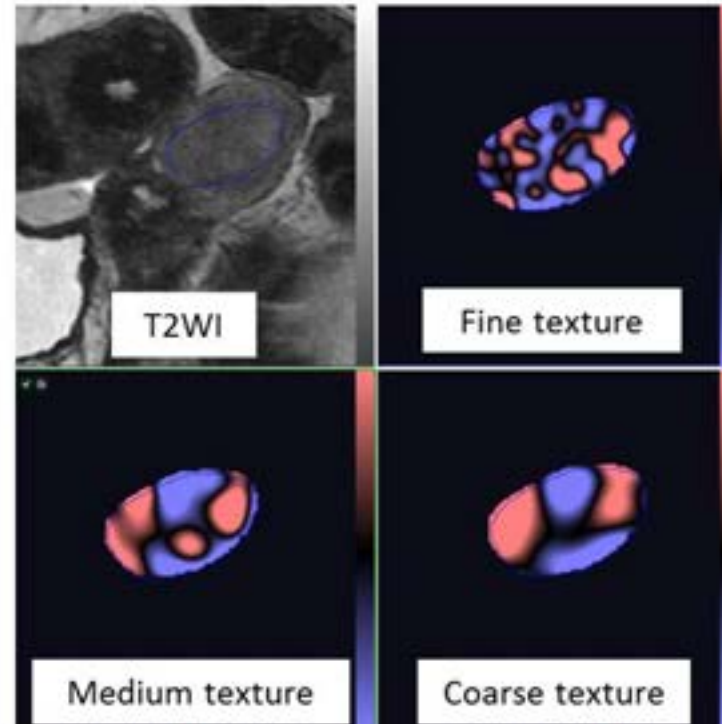


Cervix: Tunnel clusters

Computed Image Analysis



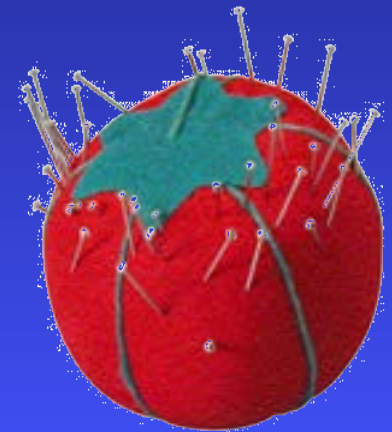
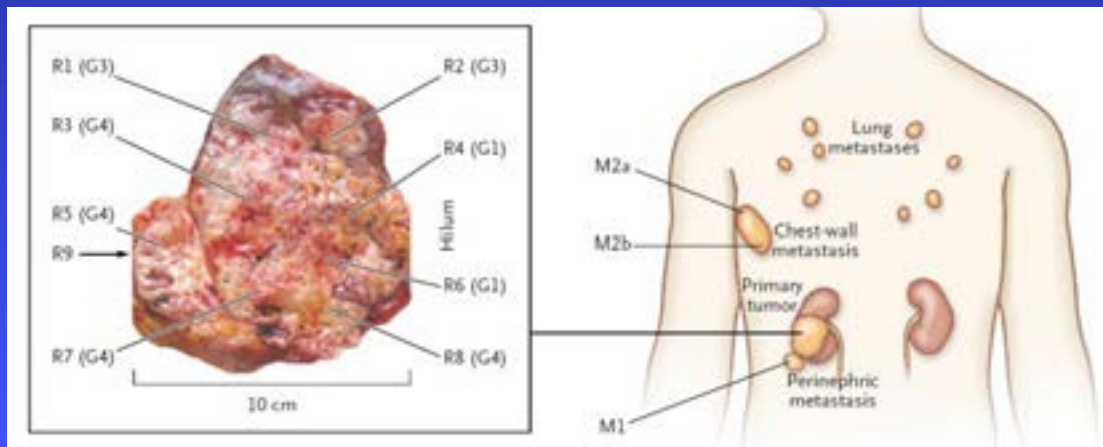
75-year-old woman
LVSI (-) Deep MI (-)

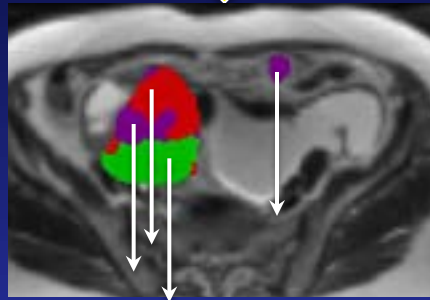
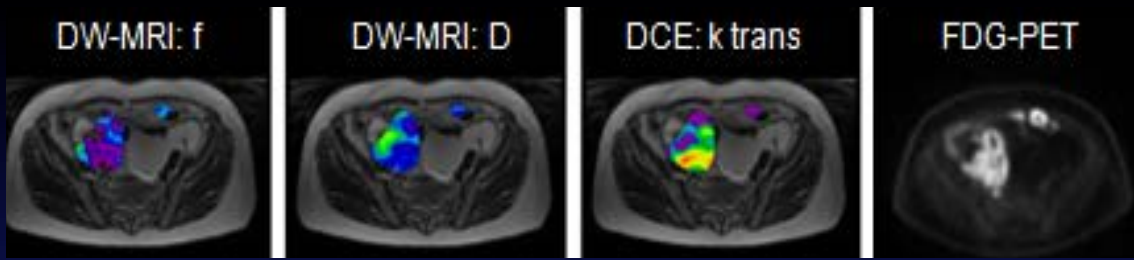


85-year-old woman
LVSI (+) Deep MI (+)

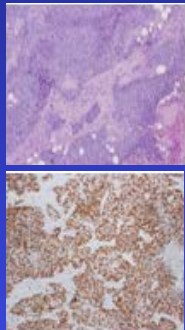
Radiogenomics – The Future!

- The current method of using single site of biopsy for analyzing genetic expression leads to an incomplete portrait of the disease due to intratumour heterogeneity
- Radiogenomic data from spatial and temporal mapping of whole tumour regions may replace multiple repeated biopsies

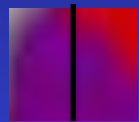




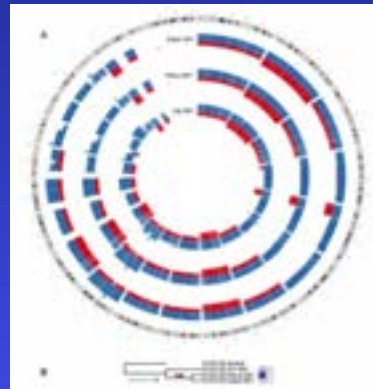
Tissue sampling of 3 spatially distinct phenotypic clusters of ovarian tumor and 1 metastatic implant



Per sample
 Histologic & IHC analysis



Genomic analysis



Integration:

Phenotypic heterogeneity associated with histological and/ or genomic heterogeneity in HGSOC

Image Analysis



Surgery



Pathology



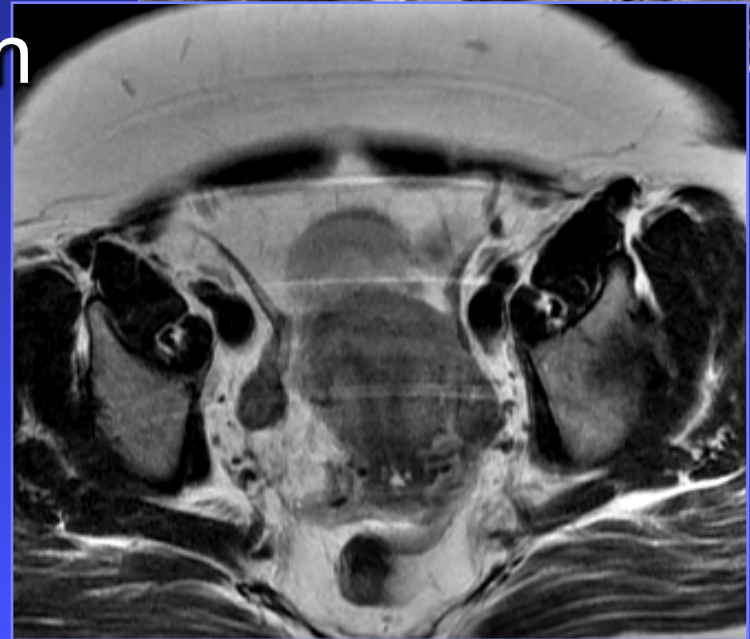
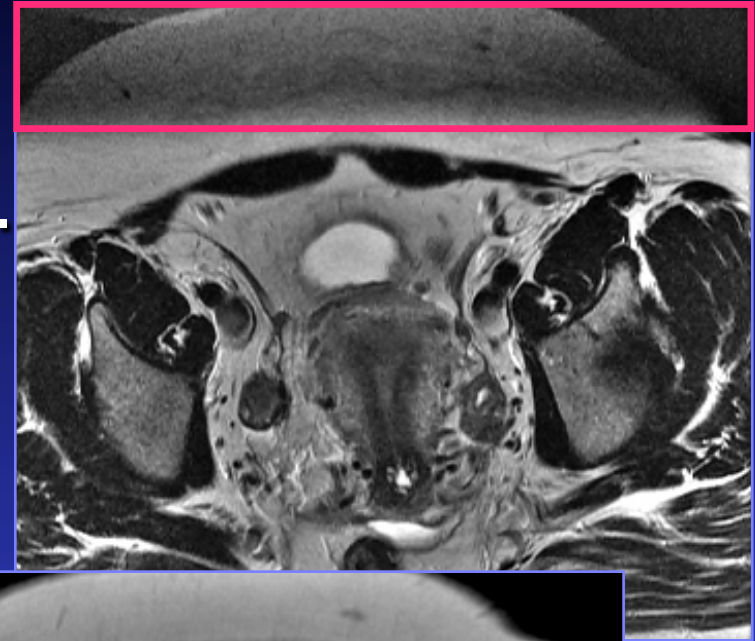
Genomics



Integrated Diagnostics

How?: MR Imaging Protocol

- Patient preparation:
 - Fasting minimum 4 hrs.
 - Empty urinary bladder
- Antispasmodic
 - 40 mg IM/IV buscopan
 - 1 mg IM/IV glucagon
- Multicoil array
 - In-FOV SAT bands
 - Critical at 3T



*Rafat Zand K, Reinhold C et al. JMRI
2007; 26:480-97*

How?: MR Imaging Protocol

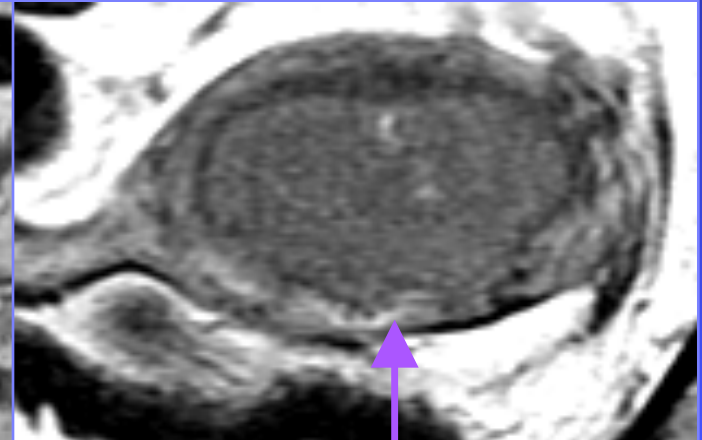
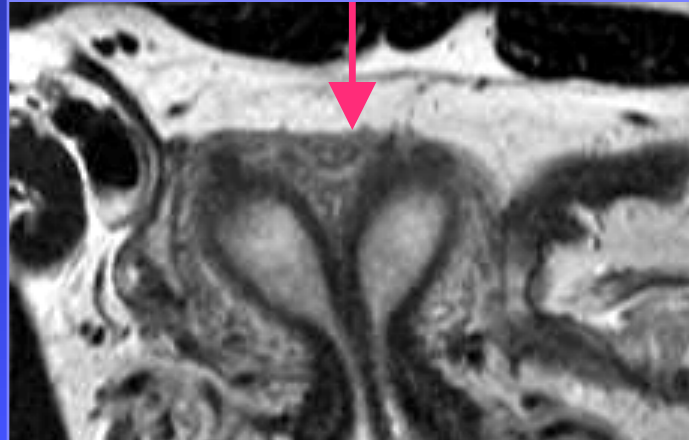
- Localizer – 3 Plane T2W
- Coronal large FOV SSSFSE
- Multiplanar HR T2W
- Axial T1W (IP, OP)
- 2D/3D fat SAT T1W
- Optional
 - DCE (perfusion)
 - Peristalsis (SSFSE)
 - DWI

Survey all
corners!



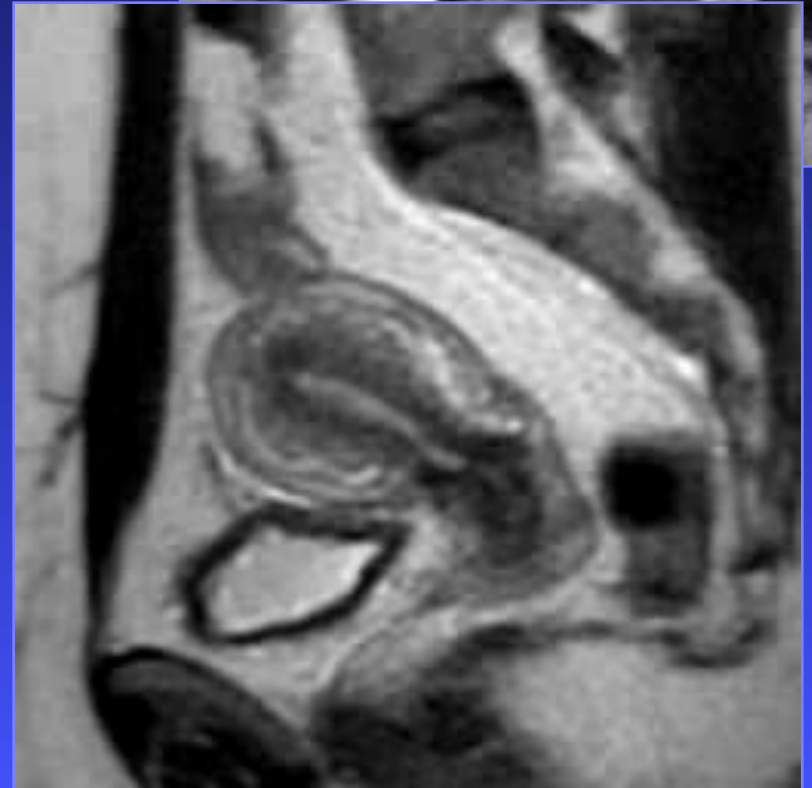
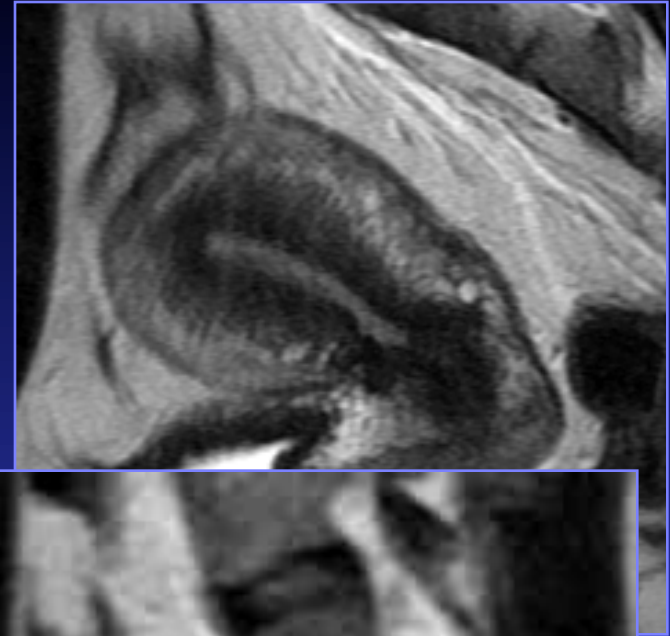
MR Imaging Protocol

- High resolution images
- FOV 20 cm, 3-4mm
- T2W FSE
 - Axial, sagittal
 - Axial obl (long-axis)
 - Cor obl (short-axis)
 - Matrix 512 x 256



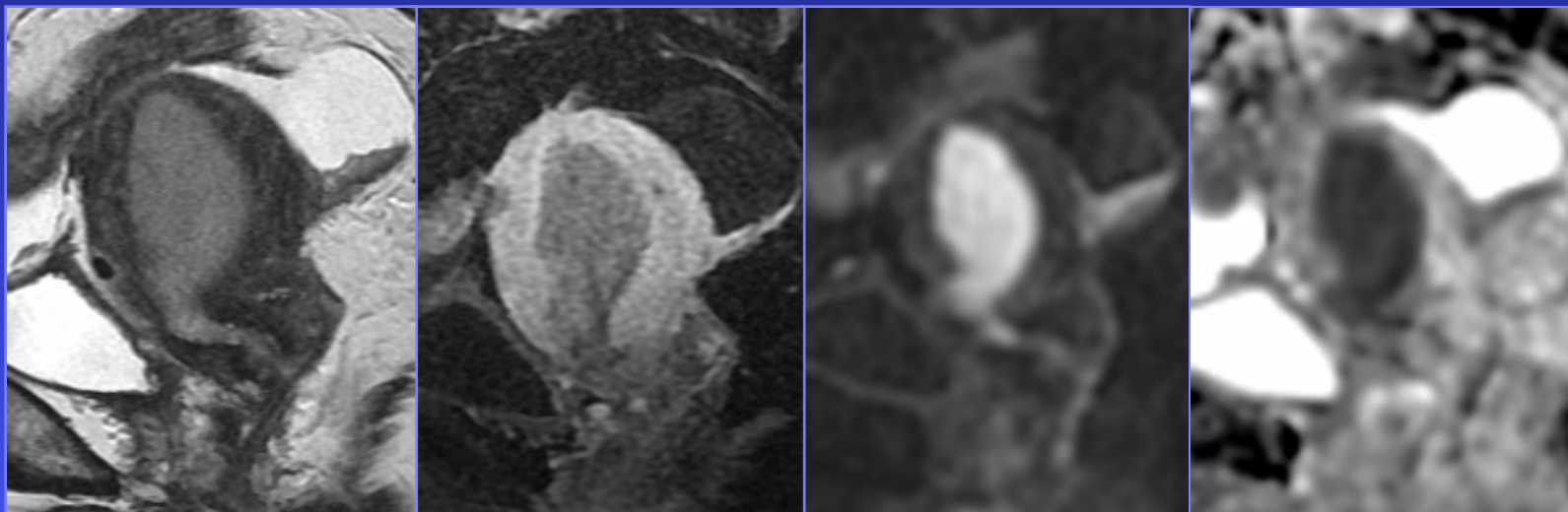
MR Imaging Protocol

- Axial SGE to renal hilum
 - Lymphadenopathy
- Peristalsis sequence
 - DDx true JZ thickening vs peristalsis
 - Menstrual phase
 - Periovulatory phase
 - SSFSE over 3 mins.
 - TR 4000ms
 - 5 mm sections
 - Matrix 256 x 192
 - Cine 12-15x



MR Imaging Protocol

- Dynamic 3D FSGR, F Sat - 3 runs
 - Gyn malignancies
 - Staging and follow-up
 - Adnexal mass characterization
- DWI Multiple B values, min (B 500, B 1000)
 - FOV 20 - 36
 - Matrix 128x128
 - NA 6



T2 FSE

T1 C+

B1000

ADC

Take Home Points



- MR imaging plays an important role in the evaluation of the female pelvis
 - Problem-solving modality
 - Modality of choice
- MR imaging protocol
 - High resolution anatomic images
 - Functional imaging